MONROE-JOSEPH
GEOTHERMAL ENVIRONMENTAL ANALYSIS
43-050-5-016

Bureau of Land Management
Richfield District
Utah

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INTRODUCTION

GEOTHERMAL RESOURCES

The earth is a tremendous reservoir of thermal (heat) energy. Heat flows beneath the surface and dissipates. This is usually not noticeable because it is dissipated in small quantities.

The increase of heat with depth is called geothermal gradient. Normally it would average about $1^{o}F.$ for every 100 feet of depth. Some areas are discharging heat at rates of 10 to 1,000 times normal. These are the areas of interest for development of geothermal energy.

The heat source that creates these near-surface "hot spots" is either:

(1) A deep-seated magma (molten rock) from which the heat escapes viz faults, or

(2) A shallow magma or magma cooling chamber in areas of fairly recent volcanic activity (within the last few million years).

Groundwater is heated by these energy sources and rises toward the surface. In some places the hot water is trapped by overlying impermeable rocks. In others it reaches the surface through faults. Hot springs, fumaroles, mud pots and geysers are the surface expressions of such escape..

Geothermal Systems

Two types of geothermal systems are considered to have present commercial application:

(1) Vapor-dominated systems (dry steam) contain both saturated steam and water in the reservoir. When a well is drilled, the decrease in pressure superheats and dries the steam. The steam may be used to drive a turbine directly. Vapor-dominated systems are believed to be relatively rare. Power production from such fields occurs at the Geysers in California, Lardarello, Italy, and Matsukawa, Japan. The Valles Caldera field in New Mexico appears to be on this type and is currently under development.

(2) Hot water systems are derived from a thermally driven convection system which moves the heated water upward. The upwelling

hot water often penetrates the surface as hot springs, geysers, etc. When a well is drilled, a portion of the water flashes into steam and both water and steam come to the surface. The steam is separated from the water and used to drive a turbine. Power production from hot water fields is currently underway at Wairakei, New Zealand, Otaka, Japan; Cerro Prieto, Mexico and Pathe, Mexico.

A. DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

PROPOSED ACTION

The proposed action described in the analysis is the leasing of federally owned geothermal resources, under the provisions of the Geothermal Steam Act of 1970 and the Geothermal Leasing and Operating Regulations. Leases would be for a primary term of ten years with provisions for renewal up to a total of fifty years if geothermal resources are developed. Lands proposed for lease are within and adjacent to the area described as the Monroe-Joseph Known Geothermal Resource Area (KGRA) (Figure 1). Federal lands within the KGRA fall into two categories:

(1) "Grandfather" application subject to conversion to geothermal leases in accordance with Section 4 of the Act and Subpart 3230 of the leasing regulations.[1]

(2) Lands subject to leasing only by competitive bidding under Section 4 of the Act and Subpart 3220 of the leasing regulations.

The potential lease area within the KGRA includes 9,385 acres of federal lands managed by the Bureau of Land Management and U.S. Forest Service, and 172 acres of private land on which the Federal Government reserved the mineral rights.

Areas adjacent to the Monroe-Joseph KGRA would be subject to non-competitive leasing except where "competitive interest" as defined in the leasing rules results in classification of the areas as a KGRA subject to competitive leasing. At present non-competitive lease applications have been filed on 6,520 acres of federal land adjacent to the KGRA. An additional 27,000 acres of national resource lands in Sevier Valley will also be examined in this analysis and may be leased at some future date.

These proposed areas would be available for leasing, as outlined in the leasing regulations.

1. 43 CFR 3200

MONROE-JOSEPH GEOTHERMAL AREA

K.G.R.A.

K.G.R.A. Competitive Interest

Existing Noncompetitive Applications

Additional Area For Lease

R. 3 W.

R. 4 W.

T. 25 S.

FISHLAKE NATIONAL FOREST

Figure 1

A detailed description of the federal geothermal leasing program and information on the uses of geothermal energy are detailed in the Environmental Impact Statement (E.I.S.) for the Geothermal Leasing Program prepared by the Department of the Interior.[2]

If leasing occurs, the following steps may be taken to tap and use the resources:

Stages of Implementation

Four separate stages of implementation have been identified:

I) Exploration
II) Development
III) Operation
IV) Close-out

The progression from one stage to the next is dependent upon the success of each earlier stage. In practice, one stage often blends into another and it would be common for exploration and development to be undertaken in one part of a geothermal field, while a production operation was going on in another part of the field. Close-out of some wells, including rehabilitation, might also be taking place at the same time.

Exploration

The exploration stage involves geologic mapping, gravity and magnetic surveys, electrical resistivity surveys, seismic surveys and shallow drilling for temperature and chemical data.

The descrete operations can be divided into two general categories: Airborne Exploration and Surface Exploration.

Airborne Exploration - Small aircraft and/or helicopters would be used to conduct a variety of exploration surveys. Low altitude geologic reconnaissance flights at 100 to 500 feet would be made for heat and magnetic sensing, and to visually search for rock outcrops that may give structural indications and lithologic data, both would be studied later by surface exploration methods. High altitude flights above 3,000 feet would be made to conduct photographic, sensing, geophysical magnetometer and geologic visual reconnaissance surveys.

Surface Exploration - Many exploration techniques require off-road vehicular travel in various degrees. Generally, existing roads are used where possible. Techniques which sometimes require cross-country travel include:

2. U.S. Department of the Interior, Final Environmental Statement for Geothermal Leasing Program, Volume 1 of IV 1973.

(1) Geological mapping - One or more small vehicles transport geologists to the work area.
(2) Geophysical exploration - Includes a number of techniques seeking clues as to underground geology:

Gravity - Ground gravity surveys involve obtaining gravity readings along a surveyed grid with a portable gravimeter. A three-man crew does the work (two survey and the third records gravity readings). One or two small trucks transport the crew and equipment to the work area.

Magnetic - Magnetic variations are measured with a magnetometer. The field technique is similar to the gravity determination.

Seismic - Elastic shock waves are generated and measured along a grid system (generally 1-2 mile grid). Receivers (geophones) pick up elastic waves generated at a specific point on the grid. The elastic waves are generated by one of three methods:

Vibration method - Vibrations are produced by truck mounted vibrators, usually four, which operate in unison.

Thumping method - A truck-drawn or self-propelled unit containing a heavy weight or "hammer" drops the hammer on the ground to produce shock waves.

Explosive method - A truck-mounted rotary drill is used to drill holes 100-200 feet deep. These holes are loaded with 5-50 lbs. of explosives and detonated (shot) to produce the elastic waves.

In all three seismic methods, 5-7 trucks and 10-15 men are required. Surface mineral matter and vegetation must be removed from the energy generation sites (shot points) and receiving sites (geophones) to provide for the maximum amount of energy to be sent and received. In addition, the explosive method often requires road construction, blading of lines and clearing of small areas for drill operation.

All three seismic methods involve varying degrees of surface disturbance. The explosive method produces the most intense surface disturbance. Only the explosive method possesses the potential for subsurface impact (damage to nearby water wells, damage to near-surface aquifers, etc.), and then only within a limited radius of the shot point.

Microseismic - Small geophones called seismometers are buried at a shallow depth and transmit normal extremely minor

seismic activity (micro-earthquakes) to an amplifier on the surface. The amplifier is about the size of a suitcase. Locations are set up away from roads to avoid traffic "noise". These units are often backpacked into areas inaccessible to vehicles.

Resistivity - Induced Polarization (IP) techniques are used to measure the resistance of subsurface rocks to the passage of an electrical current. A vehicle mounted transmitter sends pulses of electrical current into the ground through two widely spaced electrodes (usually about two miles apart). The behavior of these electrical pulses as they travel through underlying rocks is recorded by "pots" (Potential electrodes), small ceramic devices that receive the current at different locations. The electrodes are either short (2-3 feet) rods driven into the ground or aluminum foil shallowly buried over an area of several square feet. Two or three small trucks transport the crew of 3 to 5 men to transmitting and receiving sites.

Telluric - A string of "pots" (potential electodes) record the variations in the natural electrical currents in the earth. No transmitter is required. Small trucks are used to transport the crew to the work area.

Radiometric - Radioactive emissions (generally radon gas) are measured as an indication of subsurface steam. Such measurements would be made in the vicinity of the hot springs, therefore existing roads would be used. Measurements are taken with a hand held scintillometer.

Temperature - Thermal-exploration techniques would provide a direct method for assessing the size and potential of the geothermal system. Operations may involve (i) surface and shallow temperature measurements, generally at depths less than 20 feet. (ii) Geothermal-gradient surveys, generally at depths of 50 to 500 feet. (iii) Heat-flow determinations, requiring hole depths of at least 300 feet.

(3) Geochemical surveys - Includes the sampling of spring water to determine dissolved solid content (acidity, Na/K ratio and silica content) and the taking of small (hand trowel) surface soil and rock samples on a grid system to determine introduced mineralization and source areas for recharge. Occasionally small trucks are used to transport the crew (usually 2-3 men) and equipment to the work area.

Development

Development would include all activities from the decision to develop a producing field until commercial power generation and

transmission is reached. These operations would only be conducted under a geothermal lease (either competitive or noncompetitive).

Six discrete operations, as they relate to surface disturbance, are recognized:

(a) Road development
(b) Drill Site development
(c) Geothermal pipelines
(d) Plant construction
(e) Transmission lines
(f) Rehabilitation

Many of these operations would normally be taking place concurrently.

(a) Road Development

During development, roads to drill sites, power plant sites, and along transmission line routes may be constructed. Roads to producing wells and power plants would be permanent and may be surfaced and stabilized. Culverts would be utilized to avoid erosion of the road bed where necessary. Temporary roads to drill sites and for construction of power lines would generally be built to a low standard.

(b) Drill Site Development

Wells drilled during the development stage will be similar to exploration wells. Often, somewhat larger equipment is used. The drill pad is leveled and cleared of vegetation. Generally from less than one up to two acres are disturbed. A reserve pit (sump) 1,000 to 10,000 square feet and 6-8 feet deep is sometimes dug to contain waste fluids during the drilling operations. The sump may be fenced to keep out animals.

(1) Water - About 500-1,000 barrels (1 barrel = 42 gallons) of water per day will be used in drilling a well. This water may come from water wells drilled in the immediate vicinity (about 60 gpm flow would be adequate), from nearby surface water, or it may be hauled in by truck.

(2) Spacing - Current geothermal plants require a steam pressure of about 100 PSI at the generator. This places a limit on the distance steam can be piped to the generator because of heat loss. Wells would therefore generally be located within one-half mile of the generation plant. The number of wells used to service a plant is dependent on the temperature of the wells (a temperature of 325-

350°F at the generator is needed) and the characteristics of the geothermal reservoir. Generally, from 16 to 20 producing wells are used per power plant.

At Cerro Prieto, 18 wells (3 are standby) will service a 75 MW generating plant. They are drilled on a 10 acre spacing (one well per 10 acres). A 40-acre well spacing is being used at the Geysers initially, but future infill drilling to 20 acre spacing is planned in order to maintain steam production to plant capacity.

(3) Production Testing - To determine the sustained flow characteristics of a well, and to clean out the hole, each new well is vented to the atmosphere for a period of time. Steam, water and noise accompany production testing. The water is generally directed into the reserve pit and is contained. The steam is released into the atmosphere.

Noncondensable gases (carbon dioxide, methane, hydrogen, nitrogen, argon, carbon monoxide, hydrogen sulfide, radon, ammonia) and vapors (boric acid and mercury) are often contained in the steam. These vapors and gases make up generally less than 3% of the total steam fraction.

When present in excessive amounts, some of these gases and vapors are toxic.

Gas	Toxicity Levels
Ammonia	50 ppm
Boric acid	None established
Carbon dioxide	5,000 ppm
Carbon monoxide	100 ppm
Hydrogen sulfide	20 ppm
Mercury	12.2 ppb
Methane	10,000 ppm

Additionally, very small amounts of hydrogen sulfide (as small as .025 ppm) can be detected by smell. This "rotten egg" odor, common in hot spring areas, can be an aesthetic problem.

High noise levels accompany production testing. Because of this, muffling devices are generally installed. At the Geysers measurements of noise from a muffled testing well indicates a noise level slightly less than that of an unmuffled diesel truck. Noise levels from other geothermal fields, both vapor dominated and water dominated, may not be of a similar magnitude.

(4) Blowouts - In the four geothermal areas in the world (Geysers, USA; Lardarello, Italy; Wairakei, New Zealand; Cerro Prieto, Mexico) which have undergone commercial development, blowouts have occurred in approximately 1-3 of the wells drilled. These blowouts were mostly in the exploratory or early stages of development drilling, with few mishaps in later stages as experience was gained and local drilling techniques perfected. Although some of these blowouts were temporarily spectacular, none have resulted in any significant or lasting environmental damage.

At Lardarello, Italy, the oldest commercial geothermal field in the world, blowouts are routinely handled as a noisy, different part of regular operations. They are not considered as serious mishaps that could cause pollution or have other adverse effects.

(c) Geothermal Pipelines

Pipelines 10 to 30 inches in diameter will be used to transmit steam or hot water from the production wells to the power plants. The pipes are typically insulated with fiberglass or asbestos to minimize heat loss. Expansion loops or joints are placed at frequent intervals either vertically or horizontally to provide for the extreme expansion and contraction of the pipes upon production startup (heating up) and shutdown (cooling down).

Under present technology, pipelines are constructed above ground to provide for expansion and contraction and to enhance maintenance and detection of leaks. Underground installation is thus far uneconomical and may also present some safety hazards.

The lines form a radiation pattern on the surface, connecting wells with the power plant. They may be painted to blend with the surroundings.

(d) Plant Construction

Generating plants are centrally located to minimize the length of the steam or water pipes from the servicing wells. The largest plants in current use consist of two 55 MW generators housed together so that production is 110 MW per power plant. Power plant spacing is about one plant per 640 acres throughout the productive area. Twenty to thirty persons would be involved in plant construction.

At the Geysers, the average 110 MW plant building is about 100 x 200 feet and three stories high. The adjacent cooling towers are about a third larger than the generating plant building. The entire generating plant cooling tower complex occupies an area of about five acres.

(e) Transmission Lines

Power generated from the plant would be transmitted via conventional power lines to the area of use. The size and location of the lines are dependent upon the power output and destination. Rights-of-way will be examined in a separate EAR or EIS if field development occurs.

The lines would tend to be large, considering that 1 MW of plant capacity will service the power needs of about 1,000 people. To express this another way, one 110 MW power plant could supply the power needs of the Orem-Provo area.

(f) Rehabilitation

Rehabilitation will be possible on disturbed areas not needed for continued production, commensurate with terrain, climate and significance of the damage.

(1) Road development - Roads needed for maintenance and further development will not be rehabilitated. Temporary roads and trails can be scarified and revegetated, if desired.

(2) Drill Site Development - After well completion, an area approximately 30 ft. x 30 ft. directly surrounding the well head will be needed for operation. An additional graded area about 50 x 100 feet may be needed for moving in a drilling rig to correct any problems which may develop during production. The reserve pit (sump) is generally dried out, covered with dirt, and graded. It and the remaining area of the drill site can be rehabilitated and revegetated.

(3) Plant Construction - The area disturbed in constructing the generating plant and cooling towers can be rehabilitated and revegetated. The buildings may be painted to blend with the surroundings. Some cooling towers are architecturally attractive and, if desired, may be intentionally painted to contrast with the surroundings to heighten the visual experience.

(4) Geothermal Pipelines - Geothermal pipelines may be painted to blend with the surroundings and any areas not needed for access may be revegetated. At Lardarello, Italy, steam lines cross grainfields and vineyards with essentially no loss of land productivity.

(5) Transmission Lines - Surface disturbance accompanying electrical transmission line construction may be rehabilitated with the exception of needed maintenance roads.

OPERATION

The operation phase starts upon reaching commercial power production. Exploration and development are typically carried on in other parts of the geothermal field simultaneously with the operational activities.

The operation stage may be divided into the following discrete operations:

(a) New drill sites
(b) Maintenance
(c) Waste Disposal
(d) Production

(a) New Drill Sites

Geothermal fields are long lived resources. The Lardarello field has been in production since 1904 and the Geysers since 1958. The Geysers is estimated to have a minimum production life of 30 more years. Nonetheless, production slowly diminishes the heat flow and additional wells must be drilled and completed to keep the generating plant operating at full capacity.

Additional wells may also be required to replace wells that become inoperative and, if the waste waters are disposed of by injection, injection wells may be drilled.

The technique and effect of these wells would be the same as for development wells. On a major producing field, it can be expected that one or two drilling rigs would be operating continuously throughout the life of the field drilling additional or replacement wells.

(b) Maintenance

Repair, maintenance and monitoring of an operating field will require the periodic use of access roads to service the equipment. Existing wells will require occasional repair work or cleanout. The amount of this remedial work will depend upon the production characteristics of the field; severe scaling and corrosion would require frequent remedial work. Normally, one medium sized drill rig would be required full-time for each 20-30 wells (one 110 MW power plant).

(c) Waste Disposal

The work force (both construction and maintenance) for geothermal power plants will usually be housed in the nearest town rather than creating a new town at the site. Thus, waste

materials connected with human habitation will typically be handled in the local community.

At the plant site itself, sanitary facilities for workers will be provided. Solid wastes will either be disposed of in a dump developed at the site or trucked to the nearest established dump site.

The most significant waste disposal problem relates to handling the excess geothermal fluids. In vapor dominated systems, as at the Geysers, about 75-80% of the water from the spent steam is consumed in the cooling towers, leaving 20-25% to be disposed. In water dominated systems, such as Cerro Prieto, the reverse is true with 80% or more of the total well production requiring disposal.

Disposal techniques vary, depending on the quality and quantities involved. Any or a combination of the following techniques may be employed:

(1) Evaporation ponds - Waste water at Cerro Prieto is piped to evaporation ponds. Where water quality is satisfactory, such ponds may provide new aquatic habitat. Where water quality is toxic, special measures may be required to protect the ground water supply, livestock and wildlife.

(2) Natural drainage systems - At Mairakei, New Zealand, waste water is discharged into a large river. High quality water disposed of in this manner provides additional resources for agriculture, wildlife and other uses. Low quality water may require extensive treatment before it is suitable for release into natural drainages.

(3) By-product development - In some instances it may be economical to extract useful minerals or gases from the geothermal fluids. This could result in increasing the waste water quality so as to make it available for other purposes. Desalinization may also be feasible in some areas, providing by-product fresh water for other uses.

(4) Re-injection - At the Geysers, excess water is re-injected into nonproductive zones of the geothermal field. Successful reinjection is dependent on the quality of the waste water and the geological characteristics of the geothermal field. Typical considerations would include: whether plugging and scaling problems will prevent the reservoir from accepting the fluid; whether fresh water aquifers can be adequately protected from contamination by hot saline waste water; and whether the sub-surface rock structure will adequately hold the re-injected fluids.

(d) Production

Production from a geothermal field will generally require 2-5 people per plant to inspect, adjust and service the wells, making the rounds about once each day on the existing road network.

Sustained production will have several effects:

(1) Temperature drop - The field will gradually realize diminishing temperatures as the energy is utilized.

(2) Water utilization - Cooling towers will consume about 40-50 acre feet of water per year for each megawatt of plant capacity. Each 110 MW plant would thus consume about 5,000 acre feet of water per year. The water may come either from steam condensate, waste geothermal water, or from any other water source. This water consumption might be reduced by use of some technique other than conventional cooling towers. One such scheme, called the "night stream cooling system" would theoretically use only 42% as much water.

(3) Subsidence - As large volumes of water are pumped from a geothermal reservoir, some subsidence of the ground surface may occur. In many cases subsidence may have no serious land use or environmental consequences. In some situations such as developed agricultural land under gravity irrigation, minor surface subsidence could have a significant impact. Continuous monitoring might be necessary to detect whether subsidence was occurring. In some instances re-injection of the waste water might correct subsidence problems.

(4) Seismic activity - Geothermal areas are typically associated with seismic activity. Such activity is generally of small magnitude (usually less than 4.5 on the Richter scale). Fluid pressure changes from both production and re-injection may tend to increase earthquake frequency, though the relationship is not well known. To date, such earthquakes have been small and there is some evidence to suggest that this minor seismic activity tends to relieve regional stresses and diminishes the likelihood of large earthquakes. Earthquakes sometime modify geyser activity and may effect other geothermal features such as hot springs.

Close-Out

Close-out or final abandonment takes place when energy production ceases to be economical. To date no developed geothermal field has reached this stage. In a sense, geothermal reservoirs may be

somewhat renewable resources in that after a long period of rest, the fluids may become reheated to temperatures that are again useable.

Two discrete operations are expected to take place during closeout:

(A) Removal of improvements
(B) Restoration of surface

(A) Removal of Improvements

The removal of improvements from a geothermal field involves:

(1) Surface improvements - Removal of all structures constructed during field development and operations will be accomplished. Solid waste remaining may either be disposed of in a dump developed at the site or trucked to the nearest established dump.

(2) Wells - The bottom of the hole is plugged with cement and the surface casing will also be plugged with about 20 feet of cement. The casing will be cut off below the surface and a steel plate welded over the hole. A vertical steel pipe and marker would be welded to the plate. The concrete lined excavation surrounding the hole (called the "cellar") will be pushed in and the location may be graded and revegetated. The marker will remain above ground to provide identification.

(3) Restoration of the Surface

Surface restoration will typically be a gradual process, taking place throughout the life of the field and culminating with the final abandonment. Access roads can be ripped up, landscaped and revegetated. Powerlines can be landscaped and revegetated. Well and plant locations can similarly be treated but, because of their larger size, complete landscaping to approximate the original surface in steep terrain will not be feasible except in unusual circumstances.

ALTERNATIVES

For a discussion of alternate energy sources and their impact on the environment, see the Volume I of Final Environmental Statement for The Geothermal Leasing Program, U.S.D.I., 1973.

Alternative No. 1

Do not allow leasing of any lands within the Monroe-Joseph area. (No Action Alternative.)

B. DESCRIPTION OF THE EXISTING ENVIRONMENT

Non Living Components

1. Topography

The Sevier Valley, location of the proposed geothermal leasing, trends northeast and is flanked on the west by the Pavant Range and the Sevier Plateau to the east. The Joseph and Monroe segments of the KGRA are topographically separated by the Antelope Range, an eastward extension of the Tushar Range which divides the Sevier Valley in the vicinity of Joseph and Monroe, forming a short north-south extension referred to as Poverty Flat. The Monroe area is at an elevation of 5,400 feet, contrasting with the adjacent Sevier Plateau which has Monroe Peak as its highest point at an elevation of 11,226 feet. The Pavant Range due west of Joseph, attains an elevation of 7,300+ feet; this contrasts with the 5,400 foot elevation of Joseph. The intervening Antelope Range attains an elevation of 6,067 feet between Joseph and Monroe. The Richfield area, at the north of the proposed lease area, elevation is 5,300 feet.

2. Air

a. Air Movement Patterns

Sevier Valley does not have permanent wind recording devices, therefore air movement data are unavailable. General observations can however be made. The prevailing air flow is from the southwest. During the passage of frontal systems (primarily winter and spring) winds are from the northwest.

Topography is an important variable in airflow in the valley. The "venturi" effect in the area is a result of this factor. In this situation, relief features concentrate or funnel air flow through the valley. Diurnal, slope (anabatic and katabatic) winds are also related to the valley's terrain. These winds develop under a weak regional pressure gradient. The flow along the Sevier Valley develops simultaneously with upslope winds which result from greater heating of the valley's sides compared with the floor. At night the process is reversed as cold denser air drains into the valley.

b. Temperature

Table 1 illustrates the average variation of temperatures in Sevier Valley. The air is usually dry in the valley. The dry air over dry surface conditions produce ideal conditions for nocturnal radiation, leading to the formation of temperature inversions based near the earth's surface.

Table 1 - Temperatures Richfield, Utah

Mean Maximum and Minimum Temperatures and Seasonal Occurence.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
Richfield													
Max.	41.8	47.0	56.1	65.1	73.8	83.6	91.6	89.2	80.4	67.5	52.2	41.2	65.1
Min.	13.7	18.5	25.0	31.0	38.0	44.4	51.9	50.1	40.6	31.1	21.1	15.6	31.7

Frost Free Growing Season

	Avg. Date of Last Killing Frost (Spring)	Avg. Date of First Killing Frost (Autumn)	Avg. Length Growing Season	Latest Date of Killing frost (Spring)	Earliest Date of Killing Frost (Autumn)
Richfield	May, 25	Sept. 18	116	July 20	Aug. 26

c. Air Quality

Air quality monitoring in the valley has been limited. Periodic particulate measures have been taken in the Sigurd area, near two Gypsum plants, but add little to the general distribution of particulate matter in the Valley. Dust and opening buring of garbage also contribute to the "build up" of this pollutant.

Quantification of other air pollutants (oxidants, NO_x, SO_2, etc.) is unknown. The assumption is made that these are low because of the absence of industry, high population concentrations or vehicles. The Valley does, however, have an air stagnation potential, because of inversions and drainage patterns, and pollution build-ups can be expected if emission sources increase.

3. Geology

a. Stratigraphy

Almost the entire Monroe-Joseph area is underlain by Middle to Late Tertiary volcanics. The exception is the northeast portion where Jurassic Arapien Shale outcrops. A sequence of three volcanic units, each separated by an erosional unconformity, was established by callaghan: (i) an early "group of latitic breccias, tuffs and flows", the Bullion Canyon Volcanics; (ii) an intermediate "group of rhyolites, quartz latites, and tuffs", the Mount Belknap Rhyolite; and (iii) late "scattered thin basalt flows, most of which are associated with the Late Pliocene or Early Pleistocene Sevier River Formation."[3] The latter thin

3. Callaghan, E., 1939, "Volcanic Sequence in the Marysvale Region In South-central Utah: Am. Geophysical Union Trans; pt. 3 p. 438-452.

flows are associated with areas to the south of the proposed lease area. Basalt flows interbedded with the Sevier River Formation of Upper Pliocene or Lower Pleistocene age indicate that volcanism continued late into the geologic history of the Monroe region.

b. Structure

Major topographic features of the Monroe area are the result of late Tertiary volcanism and tectonic movement. The Sevier Valley is a major graben with three large boundary faults. On the east, the Sevier Fault runs the length of the Monroe quadrangle. To the west, just east of Joseph, two major boundary faults of opposite displacement are present. The Elsinore Fault has displaced the Pavant Range up relative to the downdropped Sevier River Valley. From the Sevier River south, displacement is reversed and the Antelope Range on the east side of the Dry Wash fault is the upthrown block (Figure 2). The Antelope Range is an east-trending anticlinal structure which abuts against the Sevier fault and has its crest south of the KGRA. Units in the Pavant Range dip generally southeastward.

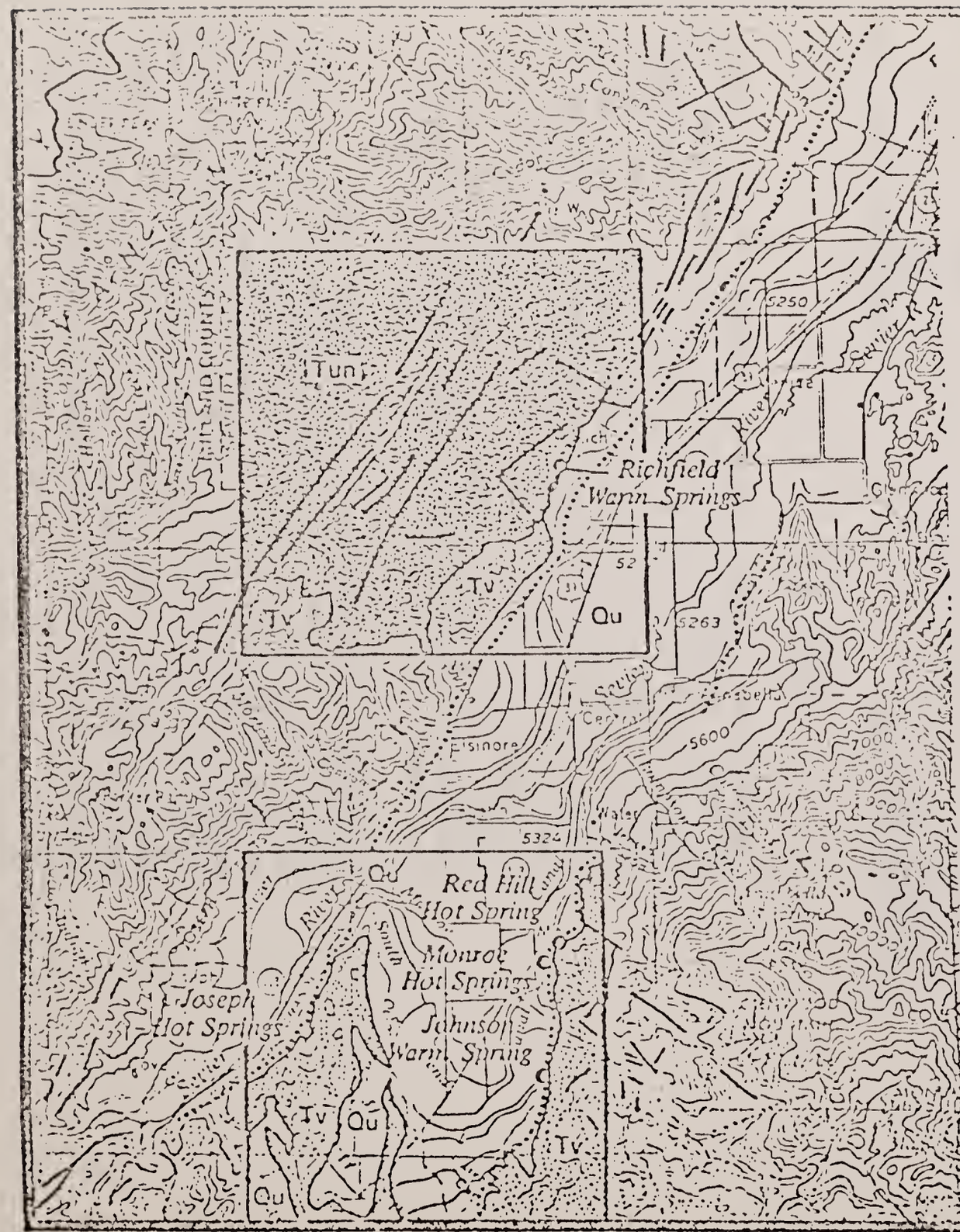
Displacement along Sevier fault is indicated by a U.S. Geological Survey test well 8 miles northeast of Monroe. At that location the Sevier Formation was penetrated at 585 feet. Outcrops of the Sevier Formation on the upthrown block indicate a displacement of approximately 1,500 feet.

c. Hot Springs

Hot springs issue just east of Joseph and Monroe. According to the Monroe geologic map, a group of six hot springs issue one-half mile east of Monroe along the Sevier fault. These springs occur laterally for a distance of one-half mile along the fault trace and are associated with mounds of calcareous tufa. According to Richardson, the spring range in temperature from 144°-156°F. (62.22-68.88°C.) and have a discharge of about 100 gpm.[4] Heylmun reported the highest temperature as 168°F.[5]

Chemical analysis of Monroe hot spring waters (Table 2) show the silica concentration to be 54 ppm. Using the silica geothermometer shown by White[6], a minimum reservoir temperature of 102°C. is indicated. In addition, Johnson Spring issues along the Sevier fault in the NE¼ of Sec. 26, T. 25 S.,R.3 W.

4. Richardson, G.B., 1907, Underground water in Sanpete and central Sevier Valleys, Utah: U.S. Geol. Survey Water-Supply Paper No. 199, 60 p., pls. 1 & 2
5. Heylum, E.B. 1966, Geothermal Power Potential in Utah: Utah Geol. and Mineralogical Survey P. 19.
6. White, D.E., 1970, Geochemistry applied to the discovery, evaluation, and exploration of geothermal energy resources: United Nations Symposium, sec. V, Proof, 43 unnumbered pages.



EXPLANATION

Qu — Unconsolidated deposits of Quaternary age

Qb — Basalt of Quaternary age

Tv — Volcanic rocks of late Tertiary age

Tun — Sedimentary rocks of Tertiary age

Spring

Contact

Fault
Dashed where inferred; dotted where concealed

0 1 2 3 4 5 6 Miles

CONTOUR INTERVAL 200 FEET
Datum is mean sea level

N

Geology from Stokes, 1954

Base map taken from AMS Topographic Series of Utah, 1:250,000.

Figure 2

Johnson Spring has a temperature of 80°F. (26.66°C.) and a discharge of 200 gpm, but calcareous tufa deposits are not shown.[7] Other calcareous tufa mounds occur along the Sevier fault within the Monroe KGRA. These mounds do not now have associated hot springs issuing at the surface but represent points where hot springs have, at one time, issued at the surface. Numerous other springs near the Sevier fault are shown on the topographic map but these are probably cold.

The Joseph portion of the KGRA is also marked by hot springs and tufa mounds. There are two tufa mounds about 1,200 feet apart and three-quarters of a mile southeast of Joseph. Both are located along the Dry Wash fault and have active springs. The northern mound is about half the size of the southern and shows one active spring. The larger mound contains six springs. Surface temperature of the springs ranges from 135°-146°F. (57.22-63.33°C.) and discharge is approximately 30 gpm.[8] A silica concentration of 85 ppm (Table 2) indicates a minimum reservoir temperature of 126°C.

Table 2

Monroe Hot Springs	Concentration in ppm
Bicarbonate	416
Calcium	288
Chloride	660
Fluoride	3
Magnesium	33
Potassium	67
Silica	54
Sodium	555
Sulfate	833
Total solids	2,860
Joseph Hot Springs	
Bicarbonate	426
Calcium	282
Chloride	1,750
Lithium	8
Magnesium	36
Potassium	68
Silica	85
Sodium	1,440
Sulfate	1,270
Total solids	5,150

7. Stearns, N.E., Stearns, H.T., and Waring, G.A., 1937, Thermal springs in the United States: U.S. Geol. Survey Water-Supply Paper 679-B, p. 183.
8. Richardson, Op. cit. p.35

Richfield Warm Springs issue at a fault contact between alluvium and sandstone of Tertiary age. In 1907 the spring discharge was 1440 gpm with a temperature of 74°F.[9] In 1966, discharge measured 700 gpm at 72°F. The dissolved solids is low, approximately 300 ppm. Principal chemicals components are magnesium, calcium and bicarbonate. The presence of faults one to five miles west of the springs, the large discharge, and relatively low dissolved solids, indicate that the spring water descends not more than 2,000 - 3,000 feet below surface and is heated by the geothermal gradient. The water is meteoric (originating as rain, snow melt or ice) and infiltrates from elevations above the springs. The Town of Richfield depends on these springs as one source of its water supply.

Summary

The geological factors described above: hot springs, tufa mounds, Late Tertiary volcanism, and basin and range type faulting are indicators of the present of geothermal resources.

d. Other Mineral Resources

An analysis of mining claims recorded in Sevier County Recorder's Office indicated 361 claims in the study area. These claims were staked principally for uranium and vanadium, but active prospecting-mining has been negligible. In the Sigurd area (northeast corner of the proposed lease) active gypsum quarries supply two local mills.

No minerals are reported to have been produced from the National Forest lands involved, but if any shipments were made, they were very small (possibly from the uranium-vanadium prospect in the SE¼SE¼ Sec. 23). Prospecting has been conducted in the area and small occurrences of locatable minerals have been found. Within or nearby the subject lands prospects for small or low grade deposits of uranium-vanadium and manganese exist. Also, small prospects and mining claim monuments in areas of alteration (primarily evident is iron oxide) were found during the field examination. Two large gravel pits are present in Section 15 about one quarter mile north of the Forest boundary. Undeveloped, minor sand and gravel deposits exist as stream-channel deposits along drainages and as landslide debris, talus, slope wash, and alluvial fans within the area.

9. Ibid

4. Soils

Nine soil associations have been mapped within the proposed lease area (Figure 3). These associations are described in Table 3 and summarized for erosional, infiltration rate (permeability) and rehabilitation potential. These factors are important in analyzing impacts and determining mitigating measures if geothermal resources are developed.

5. Water

a. Hydrological cycle: The pattern of inflow and outflow of moisture (water) within the proposed lease area is illustrated Table 4 and Figures 4-7. The table and figures deal with precipitation, evaporation and the depletion and recharge of the Valley's major stream, the Sevier River. Groundwater is an important component of the hydrologic cycle. Analysis shows that 50 percent of the total tributary inflow and river diversion reappear as surface water for rediversion downstream (Figure 7).

b. Water Quality: Tables 5 and6 provide available data for sediment, dissolved solids and coliforms. The dissolved solid concentrations in the Sevier River are less than 300 ppm at the south boundary of the proposed lease area. As the water moves downstream concentrations increase rapidly to over 500 ppm as return flows and groundwater leach salts from soils and bedrock.

Chemical pollution is not a serious problem at present, but its sources are widespread in the valley and include fertilizers, pesticides and herbicides used by agriculture. As these are leached from the valley's soils, water quality is affected. The chemicals are also transported by overland flows and ground water storage. These chemicals are often toxic in themselves or may add nutrients to the water that increases undesireable plant or bacterial growth.

6. Land Use

Lands within the study area fit into three categories; federal, state and private. Federal lands are those proposed for geothermal leasing (Figure 1) and are administered by the Bureau of Land Management (33,310 acres and the Forest Service (3,470 acres). The lands are managed for multiple use. State sections are interspersed among the federal lands and generally have similar usage to the national resource lands.

Table 3 - Soils of the Proposed Lease Area

Soil Association and Map	Parent Material	Surface Texture	Subsoil Texture	Elevation	Slope	Precip.	Erosion	Rehab. Potantial	Substratum Permeability
Reference 68 Xerochrepts 60% Calcixerolls 30% Haploxerolls 10%	Mixed Alluvium	Gravelly Loam	Gravelly Loam Lime Accum. 18"	6,200 to 7,800	3% to 20%	16" to 18"	Slight to Moderate	Good	Medium
117 Argiborolls	Volcanic Rocks	Gravelly Loam	Cobbly Clay Loam	6,800 to 7,400	25% to 65%	12" to 15"	Moderate to Severe	Fair to Good	Rapid
201 Torrifluvents	Mixed Alluvium	Sandy Clay Loam	Sandy Loam	4,800 to 5,500	1% to 6%	9" to 12"	Slight to Moderate	Good	Rapid
202 Haplaquolls Calicquolls Haplaqepts	Mixed Sedimentary	Sandy Loams to clays	Sandy Loams to clays	5,000 to 6,000	0% to 3%	7" to 12"	Negligible	Poor to Fair	Rapid
213 Lithic Torriorthents	Sedimentary &/or Igneous	Stony or cobbly loam	Cobbly Clay Loam	5,400 to 7,500	10% to 70%	7" to 14"	Moderate to Severe	Good	Rapid
233 Calciorthids 65% Torrifluvents 30% Haplargids 5%	Mixed Alluvium	Sandy Loam	Gravelly Loam	5,500 to 7,000	2% to 15%	8" to 12"	Moderate	Fair to Poor	Medium
234 Lithic Torriorthents	Mixed Sedimentary	Sandy Loam	Sandy Clay Loam	5,100 to 6,000	20% to 40%	8" to 11"	Moderate to Severe	Poor to Fair	Medium
235 Cobbly Calciorthids	Mixed Sedimentary	Sandy Loam	Loam	5,000 to 6,000	2% to 10%	8" to 10"	Moderate to Severe	Fair to Good	Medium
238 Gravelly Torrifluvents	Mixed Alluvium	Gravelly Loam	Gravelly Loam	5,100 to 6,000	1% to 10%	8" to 10"	Slight to Moderate	Poor to Fair	Rapid

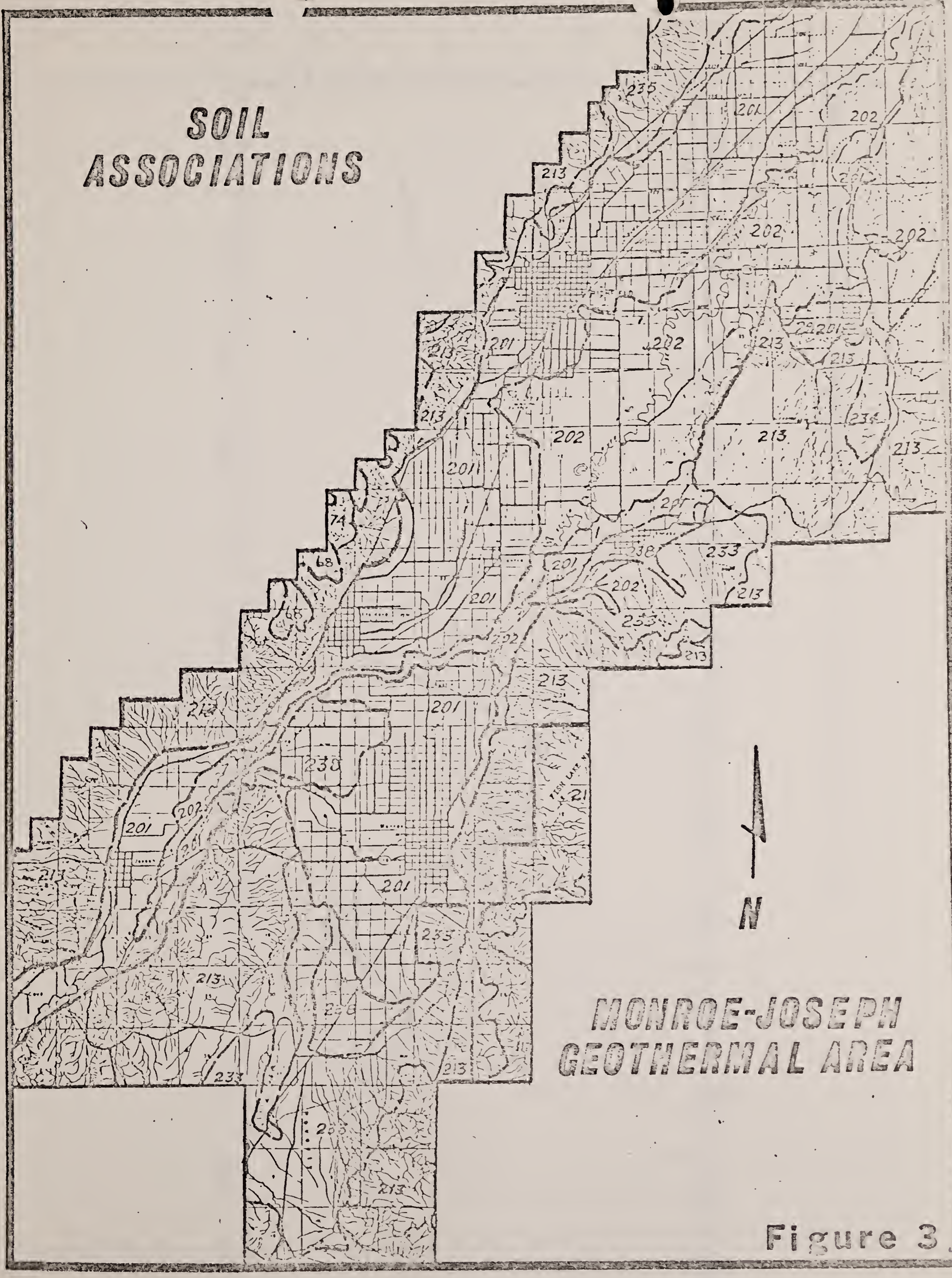
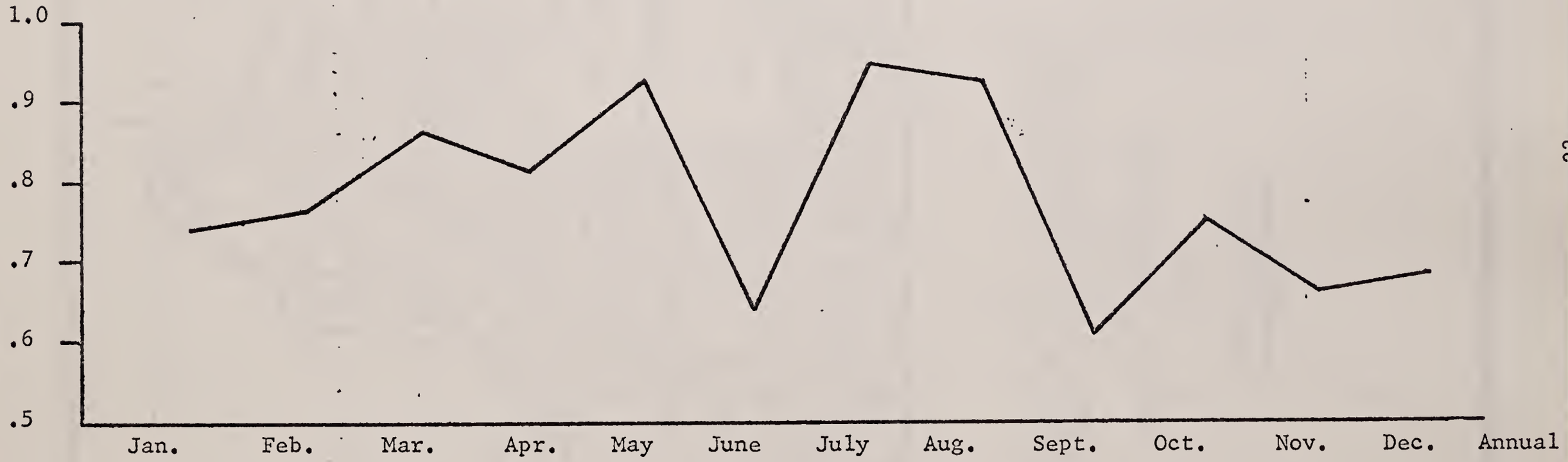
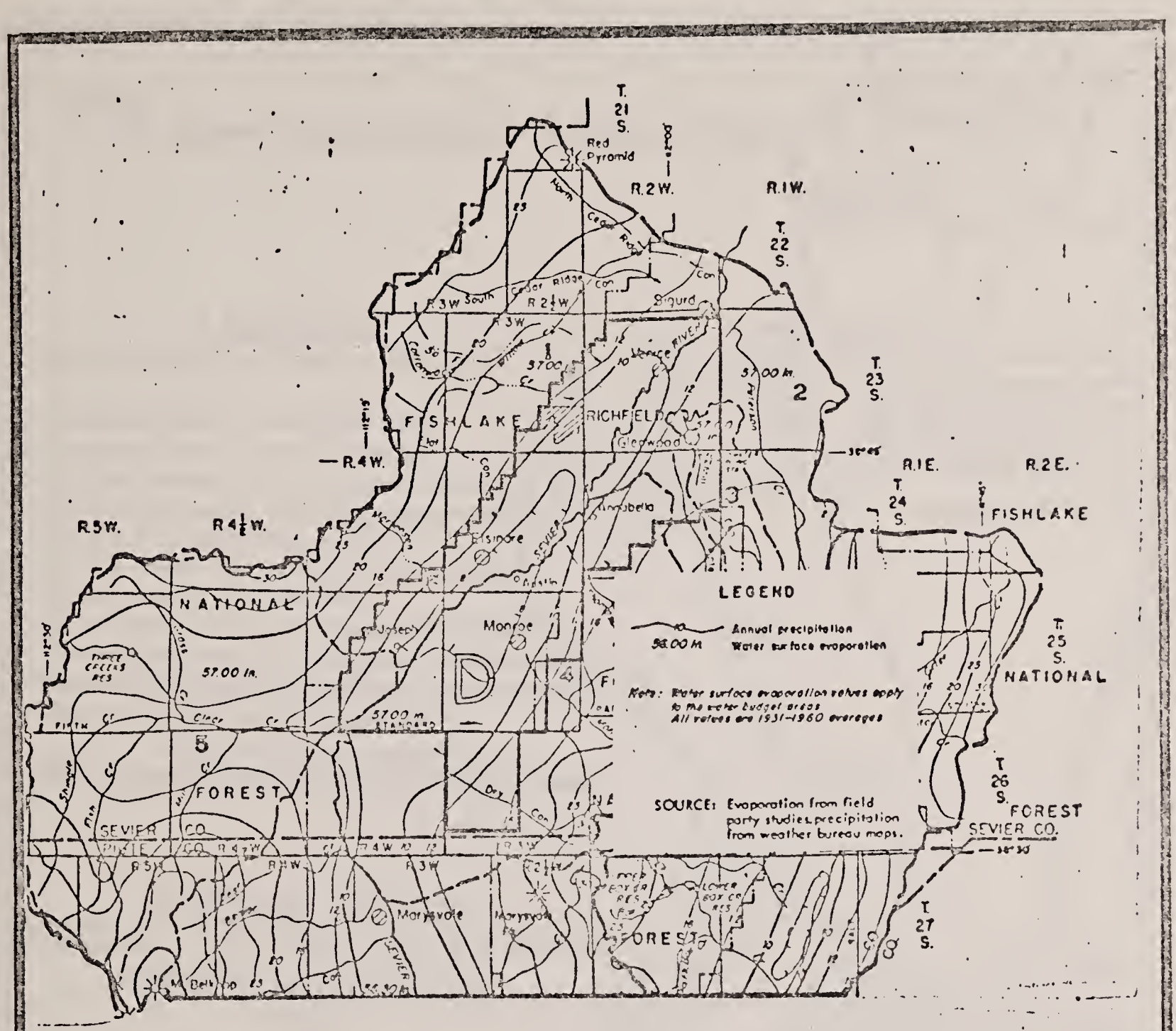


Figure 3

Table 4. - Mean Monthly Precipitation Reported at Richfield, Utah, 1931-60.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
.74	.76	.86	.81	.92	.64	.94	.92	.61	.75	.66	.68	9.31





PRECIPITATION AND WATER SURFACE EVAPORATION MAP

SOUTH HALF

SEVIER RIVER BASIN

UTAH

FEBRUARY 1969

Figure 4

Note:
All figures given in units of 1,000 acre feet.

LEGEND
(Stream Gages, Sevier River)

A - Sevier River at Hatch, Utah
B - Sevier River near Circleville, Ut.
C - Sevier River near Kingston, Utah
D - East Fork Sevier River near Antimony, U
E - River Flows Estimated
F - Otter Creek Reservoir near Antimony, U
G - River Flows Estimated
H - East Fork Sevier River near Kingston
I - Sevier River below Piute Dam near Marysville
J - Sevier River above Clear Creek near Sevier, Ut
K - Sevier River near Sigurd, Utah

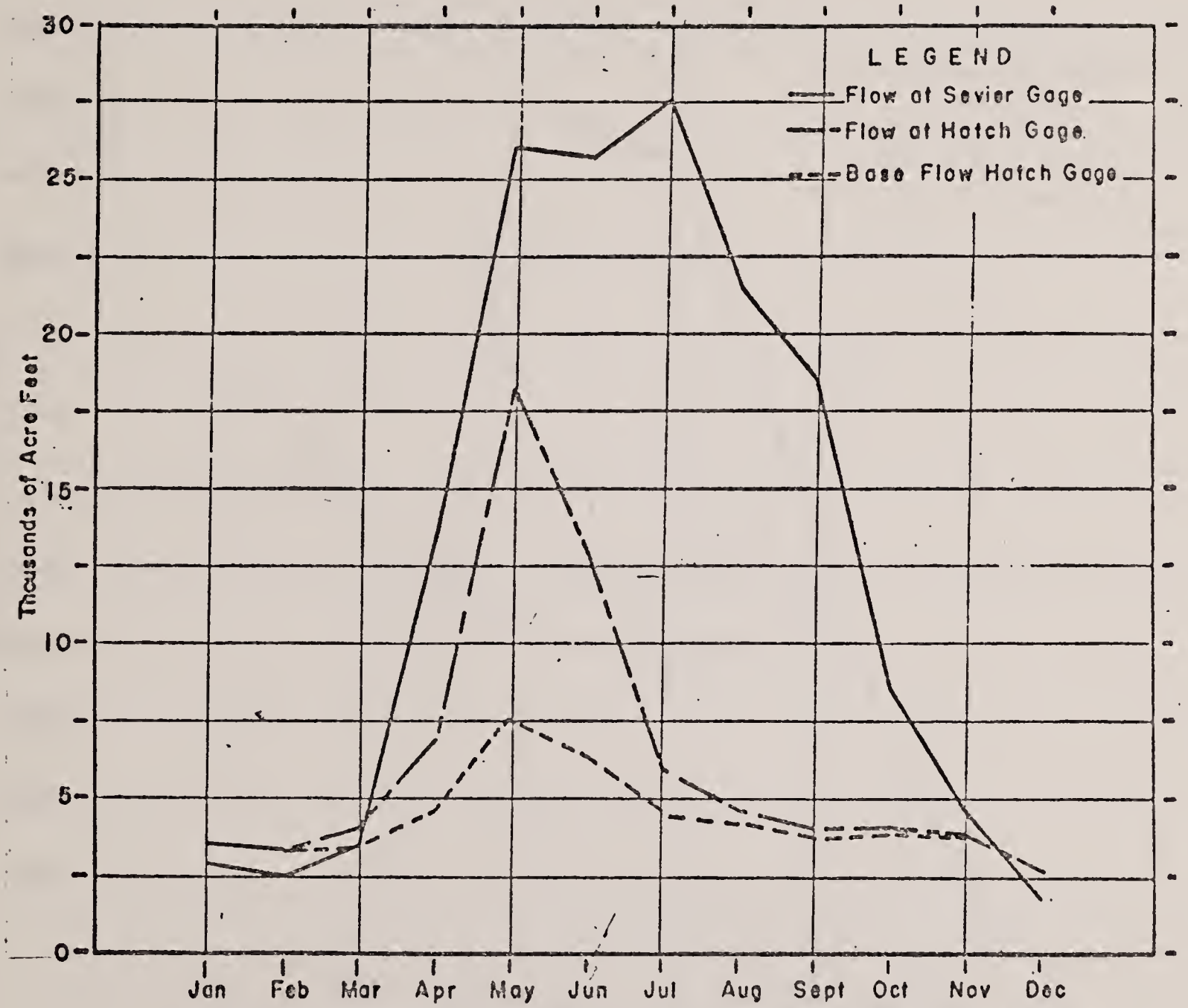
SCALE IN 100,000 ACRE FEET
1 0 1 2 3 4 5

AVERAGE ANNUAL STREAM FLOW AND DEPLETIONS SEVIER RIVER BASIN UTAH

FEBRUARY 1969

Figure 5

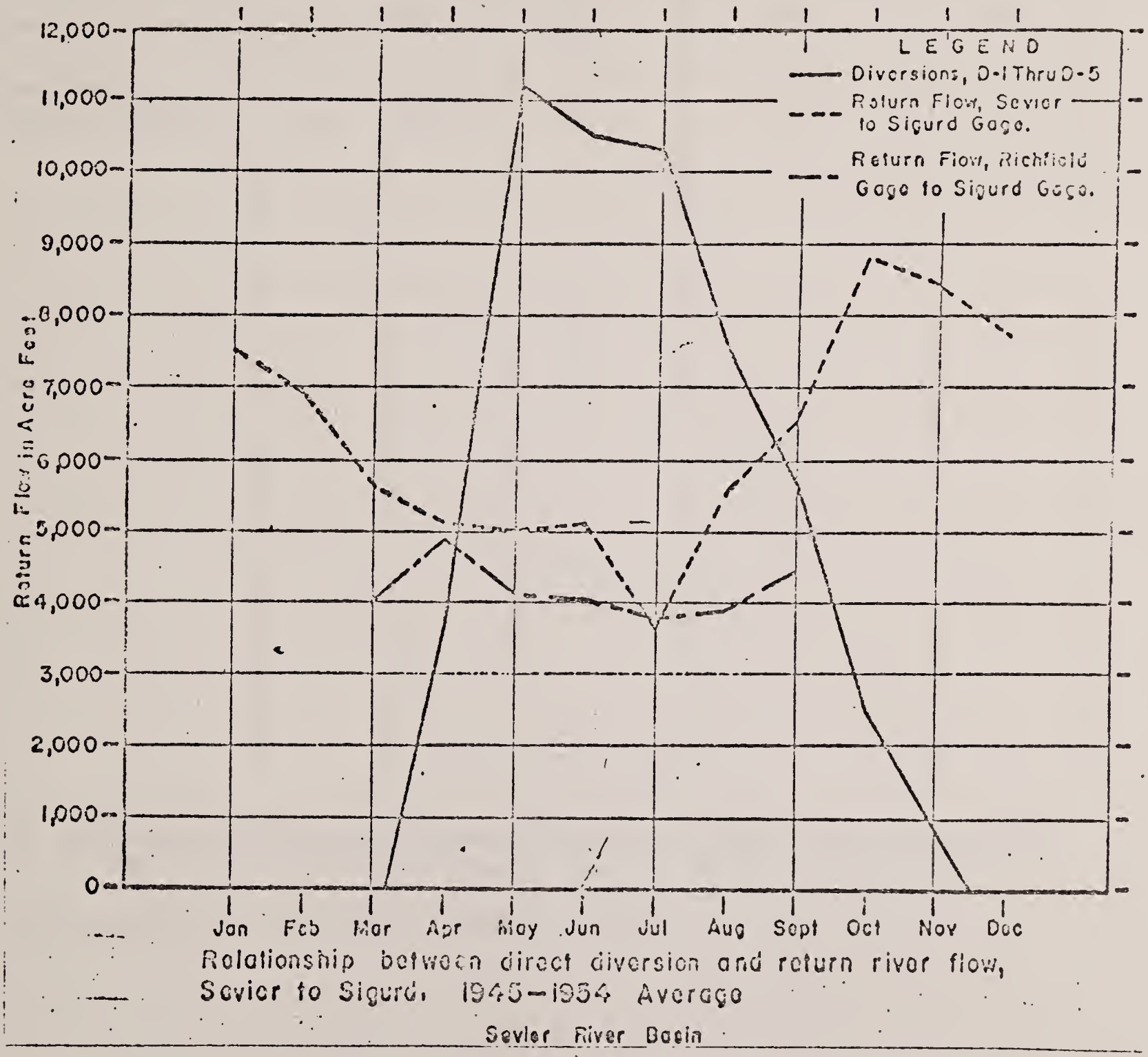
ROCKY FORD & WILLOW BEND CANAL 22.6
57.5
K
VERMILLION CANAL 16.0
RICHFIELD CANAL
22.4
6.6 ANNABELLA
ELSINORE CANAL 4.6
6.3 BROOKLYN CANA
11.6 MONROE CANAL
6.6 WELLS CANAL
18.7 MONROE SOUTH BEND CANAL
KOOSHAREM CANAL
SEVIER VALLEY & PIUTE CANAL 68.2
JOSEPH CANAL 6.9
187.8
J
Sevier River
137.3
I
JUNCTION MIDDLE DITCH
JUNCTION CANAL 4.9
80.1
C
DALTON THOMPSON CANAL
WEST CANAL 9.3
ALLEN DITCH
KINGSTON MAIN
OLD KINGSTON
LOSS CREEK CANALS
4.3
3.7
3.1
E
EAST FORK FEEDER CANAL
81.0
B
Otter Creek
MARSHALL DITCH 1.5
BEAR CREEK CANAL 2.1
ZONE 'A'
East Fork Sevier River
DARTON-LE-FEVER TEBBS DITCH
6
MR EWEN CANAL
EAST PANGUITCH CANAL 7.6
SKOWALTER & RIGGS 0.6
LONG & EAST 14.8 BENCH CANAL
HILLSDALE DITCH 1.0
TROPIC & EAST FORK CANAL 2.4
0.8
UPPER WILSON DITCH
Sevier
74.1



Typical hydrographs of regulated and unregulated river flow, Sevier and Hatch gages. 1931—1960

Sevier River Basin

Figure 6



Relationship between direct diversion and return river flow, Sevier to Sigurd, 1945–1954 Average

Sevier River Basin

Figure 7

TABLE 5 - SEVIER RIVER

WATER QUALITY [a]

LOCATION	DISCHARGE (cfs)	DISSOLVED SOLIDS PPM	DISSOLVED SOLIDS Tons per day	COLIFORMS[b] per hundred Milliliters	SEDIMENT PPM	SEDIMENT tons per day
Sevier River, Sevier	131	297	101	90	109	80
Sevier River, Glenwood Road	33	581	43	843	-	-

a. Average 1964. Base on "Quality of Surface Water in the Sevier Lake Basin, Utah," U.S.G.S. Utah Basic-data Release No. 10,1965.

b. Accepted safe standard is 2,000 per 100 mi.

TABLE 6 -Average sediment yield from selected drainages, Sevier River Basin

Reservoir or debris basin and drainage of nearest town	Drainage area		Annual Water yield per square mile	Annual sediment rate per square mile
	Square miles	Acres	Acre-feet	Acre-feet
Cottonwood Fan, Richfield	16.67	10,670	205	1.70
Flat Canyon, Elsinore	14.48	9,270	55	0.72
Mill Canyon Ret. Str., Glenwood	17.50	11,200	40	0.40
Magleby Reservoir, Monroe Creek	2.95	1,890	320	0.31
Sand and "H" Canyon, Monroe	2.34	1,500	80	1.10

Private lands are located in the valley floor. Irrigated agriculture is the principal land use. Water from the Sevier River and local creeks are delivered through a series of canals (Figure 5) to irrigate approximately 37,000 acres. Typical cropping is alfalfa, 6 to 8 years; small grains, 2 to 3 years; and/ or corn silage, one year. Wet meadows are located in the high water table areas adjoining the Sevier River. These meadows (6,000 acres) are used for pasture with some wild hay harvested where conditions permit.

The spatial arrangement of towns and residential areas are shown in Figure 1. These communities are linked by U.S. Highway 89 or State roads. U.S. 89 is the major artery through the area. Figure 8 shows the proposed route of Interstate -70 through the proposed lease area. Preliminary survey have been made for the entire route. Construction scheduling is indefinite because of funding. The segment from Sevier Junction to Elsinore is tentatively set for 1967-77.

A 138 KV line extends along the western side of the valley and is located on private and national resource lands. The latter lands are included within the proposed lease. Utah Power and Light Company has proposed construction of a 230 KV transmission line from Sigurd substation to Cedar City. The proposed route (Figure 8), located on the east side of the valley, would traverse the KGRA and the adjoining proposed geothermal lease areas. If the right-of-way is granted (EIS has been prepared) construction could commence in the summer of 1975.

LIVING COMPONENTS

Vegetation and Animals

There are five (5) general types of wildlife habitats on proposed leaseable lands and the adjoining private and state lands (Figure 9). The habitats support a diversity of mammals, amphibians, reptiles, birds and aquatic life (Table 7). Some species are in multiple habitats; others are restricted in their distribution. The relationship of each species to habitat are shown in Table 7. Riparian habitat is included in the table, but areas are not shown on the small scale map. The Sevier River and perennial streams are included in this habitat.

Ecological Interrelationships

Man's influence, direct and indirect, is a significant factor in present ecological interrelationships in the proposed lease areas in Sevier Valley. His introduction of livestock grazing in the 1860's and subsequent continuation of this agricultural pursuit has caused ecological changes. The development of irrigated agriculture changed moisture relationships in the valley and continues to be significant

PROPOSED
RIGHTS OF WAY

R. 3W.

R. 4 W.

T. 25 S.

T. 26 S.

FISHLAKE NATIONAL FOREST

GEOTHERMAL
AREA

Figure 8

GENERALIZED VEGETATION

mountain brush 1
pinyon-juniper 2
sagebrush 3
irrigated 4
wetlands 5

R. 3 W.

R. 4 W.

T. 25 S.

FISHLAKE NATIONAL FOREST

GEOTHERMAL AREA

Figure 9

Table 7 - Wildlife Species Found in Geothermal Resource Area

Common Names	Habitat Types						Comments
	Pinyon/ Juniper	Mountain brush	Sagebrush	Irrigated	Wetlands	Riparian	
Amphibians							
Tiger Salamander				X	X	X	
Rock Mt. Toad				X	X	X	
Great Basin Spadfoot Toad				X	X	X	
Reptiles							
Leopard Lizard	X		X				
No. Plateau Lizard	X	X	X				
Northern Sagebrush Lizard	X	X	X				
Northern Side blotched lizard	X	X	X				
Whiptail lizard ?							
Skink							
Snakes							
Western Yellow-bellied racer	X	X					
Utah Mountain Kingsnake	X	X					
Striped Whipsnake (racer)	X	X	X				
Great Basin Gopher Snake	X	X	X				
Wandering Garter Snake				X	X	X	
Mammals							
Shrew (Sp.)	X	X	X			X	
Pallid bat							
Western big eared bat							
Big brown bat							
Hoary bat							
Silver haired bat							
Long-legged Myotis							
Western pipistrel							
Mexican free-tailed bat							
Antelope ground squirrel	X	X	X				
Rock squirrel	X	X	X	X		X	
Porcupine	X	X	X			X	
Cliff Chipmunk	X	X	X				
Least Chipmunk	X	X	X				
Mountain Meadow Vale	X	X	X				
Louse Mouse	X	X	X	X	X	X	
Desert Wood rat	X	X	X				
Muskrat				X	X	X	
Canyon mouse	X	X	X				
White footed deer mouse	X	X	X	X	?	X	
Pinyon mouse	X						
Gopher	X	X	X	X			
Grey fox	X	X	X	X			
Coyote	X	X	X	X	X	X	
Bobcat	X	X	X			X	
Mt. Lion	X	X					
Striped Skunk	X	X	X	X	X	X	
Spotted skunk	X						
Long-tailed weasel	X	X	X	X		X	

Table 7 - Wildlife Species Found in Geothermal Resource Area

Common Names	Habitat Types						Comments
	Pinyon/ Juniper	Mountain brush	Sagebrush	Irrigated	Wetlands	Riparian	
American Avocet				X	X		
Black-necked Stilt				X	X		
Wilson's Phalarope				X	X		
California Gull				X	X		
Rock Dove			X	X	X	X	
Mourning Dove	X	X	X	X		X	
Screech Owl			X	X		X	
Great Horned Owl	X	X	X	X		X	
Long eared Owl	X	X	X			X	
Short Eared Owl			X	X	X	X	
Common Night Hawk	X	X	X	X		X	
Several Species - Hummingbirds	X	X	X	X		X	
Kingfisher					X	X	
Common Flicker	X	X	X	X*			
Yellow-bellied Sapsucker	X	X		X*		X	
Hairy Woodpecker	X	X		X*		X	
Downy Woodpecker	X	X		X*		X	
Western Kingbird			X	X		X	
Say's Phoebe			X	X		X	
Several Species - Flycatchers	X	X	X	X		X	
Horned Lark	X		X	X			
Several Species - Swallows				X	X	X	
Stellers Jay		X					
Pinyon Jay	X	X	X				
Clark's Nutcracker		X					
Black-billed Magpie	X	X	X	X	X	X	
Common Raven	X	X	X	X	X	X	
Chickadee's	X	X				X	
Plain Titmouse	X	X	X			X	
Verdin	X	X	X			X	
Bushtit	X	X	X			X	
Nuthatches	X	X	X		X		
Dipper						X	
House Wren			X	X		X	
Bewick's Wren	X		X	X		X	
Canon Wren	X		X			X	
Sage Thrasher	X		X				
American Robin	X	X	X	X	X	X	
Hermit Thrush	X	X	X				
Bluebirds	X	X	X	X		X	
Blue=Gray Gnatcatcher	X	X	X			X	
Loggerhead Shrike	X	X	X	X		X	
Starling	X	X	X	X	X	X	
Gray Vireo	X	X	X	*	*	X	
Virginia Warbler	X	X	X	*	*	X	
Yellow warbler	X	X	X	*	*	X	
Yellow-rumped warbler	X	X	X	*	*	X	
Blackthroated Gray Warbler	X	X	X	*	*	X	

Common Names	Habitat Types						Comments
	Pinyon/ Juniper	Mountain brush	Sagebrush	Irrigated	Wetlands	Riparian	
Racoon					X	X	
Badger	X	X	X	X		X	
Mule Deer	X	X	X	X		X	
Pied billed grebe					X		
Great blue Heron					X	X	
Snowy Egret					X	X	
White faced Ibis				X	X		
Whistling Swan					X		
Canada Goose				X	X		
Mallard duck				X	X		
Gadwall				X	X		
Pintail				X	X		
Green winged Teal				X	X		
Cinnamon Teal				X	X		
American Wigeon				X	X		
Northern Shoveler				X	X		
Wood duck					X		
Red head					X		
Ruddy duck					X		
Mergansers Common Red breasted					X		
Sharp Shinned Hawk	X	X	X	X		X	
Coopers Hawk	X	X	X	X		X	
Red tailed Hawk	X	X	X	X		X	
Swainsons Hawk	X	X	X	X		X	
Rough-legged Hawk	X	X	X	X		X	
Ferruginous Hawk	X	X	X	X		X	
Golden Eagle	X	X	X	X		X	
Bald Eagle			X	X	X	X	
Marsh Hawk	X	X	X	X	X	X	
Prairie Falcon			X	X		X	
Peregrine Falcon			X	X	X	X	
American Kestrel (Sparrow Hawk)	X	X	X	X	X	X	
Blue Grouse		X					
Quail			X	X		X	
Pheasant			X	X	X	X	
Chukar	X		X				
Sandhill Crane			X	X			
Virginia Rail				X	X		
Sora Rail				X	X		
American Coot				X	X		
Killdeer				X	X		
Long billed Curlew				X	X		
Spotted Sandpiper				X	X		
Willey				X	X		
Greater & Lesser Yellowlegs				X	X		
Least Sandpiper				X	X		
Western Sandpiper				X	X		
Marbled Godwit				X	X		

Common Names	Habitat Types						Comments
	Pinyon/ Juniper	Mountain brush Sagebrush	Irrigated	Wetlands	Riparian		
Grace's Warbler	X	X	X	*	*	X	
MacGilliray's Warbler	X	X	X	*	*	X	
Common Yellowthroat	X	X	X	*	*	X	*In trees
House Sparrow	X	X	X	X	X	X	
Meadowlark	X		X	X	X	X	
Yellow-headed Blackbird				X	X	X	
Red-winged blackbird				X	X	X	
Brewer's Blackbird				X	X	X	
Brownheaded Cowbird				X	X	X	
Northern (Bullock's) Oriole				X*	X*	X	
Western Tanager	X	X	X	X		X	
House Finch			X	X*	X*	X	*In trees
Gold Finch			X	X	X	X	
Green-tailed towhee	X	X	X			X	
Rufous-sided Towhee	X	X	X			X	
Savannah Sparrow	X	X	X			X	
VesperSparrow			X	X			
White-Crowned Sparrow	X	X	X	X		X	
Lincoln's Sparrow	X	X	X	X		X	
Song Sparrow	X	X	X	X		X	
Dark-eyed (Oregon) Junco	X	X	X	X		X	
Gray-headed Sparrow	X	X	X	X		X	

No attempt has been made to include invertebrates or animals which are occasional or hypothesized residents or visitors.

in explaining the area's water budget. Construction activities, such as highways, utility corridors, etc. continue to alter existing ecosystems.

Because comprehensive ecological research has not been undertaken in Sevier Valley, it is necessary to use a general conceptial framework to explain energy flows and nutrient cycles.

There are four basic levels of energy and nutrient consumption- production: (1) nutrient sources, (2) Nutrient producers, (3) nutrient consumers, and (4) decomposers.

Energy is transfered from one level to the next by the plants using water, minerals and sunlight to grow; by animals eating the plants; and by animals eating animals. The amount of energy transfered decreases from one level to the next as each level uses energy for growth and respiration. The energy used is not transferred, but lost to the next level.

Plants, insects, animals, birds all return to the energy source through the decomposers. All levels will return waste and dead organic matter to the land. Decomposers (bugs, worms, larvae) break down the dead matter into simple substances. This is then returned to the energy source and made available for reuse. Each plant, plant eater, or meat eater is dependent upon the energy level preceding it for the special food, water, and cover required by each species. The removal of any component (insect, plant, or animal) results in the loss (to the next level) of the energy contained in that organism. As a result, a population may diminish through a decrease in food supply.

The ecosystem can be altered by removal of vegetation. The affected areas become uninhabitable to existing species so other plants, animals, etc. move into the area to replace them. The replacement population is desirable or undesirable depending upon the value placed upon the existing situation. Therefore, surface disturbance can obliterate historic sites, decrease environmental qualities, and advance or retard natural succession by many years.

Available moisture and temperature are critical factors influencing life directly and indirectly. The period of optimum energy for plant growth in the valley lacks adequate soil moisture. This limits plant growth which in turn restricts the habitat for animals dependent upon plants for food and cover. This food-cover-habitat relationship is particularly evident around springs and other perennial water sources.

Water moves through an eco system in different ways.
This movement of water from the ocean to atmosphere to land and back to the oceans is known as the hyrologic cycle. Water which reaches the soil may pass through and leave the ecosystem by way of springs, streams or underground channels.

Any surface disturbance affects the hydrologic cycle. Runoff from these areas will cause eroded materials to run into the lakes and streams. Gases emitted into the atmosphere may eventually be carried through the hydrologic cycle. Thus, there is a constant flow of energy, water and chemicals through any ecosystem. As long as input balances output, the system remains stable. If losses exceed the input, as so often occurs when man interferes with the natural scene, then the system breaks down; the community is replaced by one of a different kind; or in severe cases, is completely destroyed.

Human Values

1. Landscape Character

   a. Harmonious: The subject area is typical of the mountain-valley relationship found within the intermountain areas of Utah. Vegetation types on the hillsides and the checkerboard pattern of irrigated agriculture is replicated in other valleys in the State. The colors are drab except for the red and brown hues of the sandstone formations in the northwest. The small town size and absence of industry contribute to an impression of tranquility. Only on a micro-scale is the harmonious landscape character interruped by powerlines, canals and road scars.

   b. Inharmonious: Solid waste sites, located adjacent to the communities, and agricultural developments (feed lots) are sources of pollutants and odors that detract from the natural setting. Dust from two gypsum plants located at Sigurd primarily affect the landscape's quality at that location. With the exception of traffic noise, the ambient noise levels are low.

   c. Accentuating Features: Several natural features in the local environment accentuate the landscape characteristics. The Tusher Mountains, south of Sevier Valley, rise to 12,000 feet and remain snow-capped for 10 months. The alternating red and brown formations near Richfield also lend interest and variety to the landscape. Sevier River, with its ox-bows and marsh areas also accentuate the setting.

2. Socio-Cultural Interests

   Education/Scientific

   (i) Archeological discoveries within Sevier Valley have added scientific data concerning past human occupance. Geologic remains and strategraphy indicate prehistory may extend back to early man and clovis period. Clovis points have been located near Salina (north of the proposed lease area) and 40 miles to the west.

DOCUMENTED ARCHAEOLOGICAL VALUES

PETROGLYPH SITES

TEMPORARY ENCAMPMENTS

CHIPPING STATIONS

GEOTHERMAL AREA

R. 3 W.

R. 4 W.

T. 25 S.

FISHLAKE NATIONAL FOREST

Figure 10

SUSPECTED ARCHAEOLOGICAL VALUES

HABITATION SITES *h*

TEMPORARY ENCAMPMENTS *e*

CHIPPING STATIONS *c*

PETROGLYPHS *p*

R. 3 W.

R. 4 W.

T. 25 S.

FISHLAKE NATIONAL FOREST

GEOTHERMAL AREA

Figure 11

Fremont settlement patterns (700 to 1250 AD) recognized elsewhere sheds light on archaeological values in Sevier Valley. A preliminary archaeological survey was made in December, 1974 by a BLM staff archaeologist. Figure 10 shows the distribution of documented archaeological values. This data suggests that large habitation sites existed on the valley floor where horticulture was practiced and large populations gathered during winter months. Temporary encampments, hunting and chipping sites, occupied during summer months were at higher elevations where wild game and lithic materials for tools were abundant.

(ii) The hot springs described in the geologic section of this document have scientific value because they are surface indicators of potential geothermal resources. The spring areas have been altered by private landowners that have held these patented lands. Future plans of the present landowner of the Monroe Hot Springs call for development of a health spa, condominiums, and trailer courts. Preliminary engineering on the spa's residential subdivision has been completed.

Cultural Values

Cultural values from pre-Mormon settlement have been identified above. Within the communities are residences, and other buildings that are associated with the latter culture. The culture landscape is typical of Utah's rural areas. A review of literature and field work indicated neither historical structures or important cultural values from early Mormon settlement are located on federal lands proposed for lease.

A small group (35) of Paiute Indians from the Koosharem Band reside on the periphery of Richfield. The "village" is a residential settlement and has no unique historic or cultural significance.

Social Welfare

The area examined in this analysis encompasses 80% of Sevier County's population. The only sizeable towns which would not be directly affected are Salina (15%) and Aurora (4%). The total population of Sevier Valley in 1974 was 11,500.

Towns which are adjacent to proposed leaseable lands are: Annabella, Austin, Central, Elsinore, Glenwood, Joseph, Monroe, Richfield, Sigurd and Venice (Figure 1). Population has shown a slight increase since 1950 with Richfield having the greatest increase. It is the service hub for South-Central Utah.

Government, construction and services are the major employees (3,030) and agriculture added 1,790. The non-agricultural segment has increased dramatically since 1960. The average monthly income (476.) is below the national average.

Local Regulatory Structure

The County is zoned, but a master plan has not been prepared. The land proposed for lease falls into GRF (grazing, recreation, and forestry) and O-1 (Outlying) zoning categories. The zoning restrictions are vague as to what may be permitted in each zone. If geothermal development occurs, changes may be needed to handle economic stimulation and "new" land use demands. At present land use planning or land management is not widely accepted by local citizenery.

C. ANALYSIS OF PROPOSED ACTION AND ALTERNATIVES

PROPOSED ACTION

1. Environmental Impacts

a. Anticipated Impacts

The components identified in Part B of this document will be analyzed in relationship to the four stages of implementation discussed in Part A: exploration, development, operations, and close-out. Because the specific locations for each operation cannot be identified at this time, a generalized approach is necessary in this analysis.

Anticipated Impacts on Non-Living Components

Air: - Exploration: Exploratory impacts from geothermal gases or vapors will be primarily from gases vented to the atmosphere during drilling and testing either accidentally or deliberately.

Use would be relatively short (one year) and it would be unlikely that these gases would be produced in quantities sufficient to cause a significant impact upon the environment.

An increase in the quantity of exhaust by-products over the quantities now present in the areas would be negligible. These gases would be produced by the internal combustion engines used to power the heavy machinery, vehicles, drilling equipment, aircraft, etc., used during the exploration phase.

Particulate matter (dust) would be generated by the transit of vehicles (both on and off road), during the construction of roads, trails and drill pads to allow the entry and use in the area of drilling and geophysical equipment, and personnel. Relatively smaller amounts of dust would be generated by actual exploration and test drilling.

Airborne dust is offensive to humans and animals and in large quantities can affect plant life. Dust, generated during this phase, would not cause long term impact, but would cause intermittent degradation of air quality in the vicinity of exploration operations.

These impacts would also continue through the development and operation phases.

Development: Emissions of gases and vapors would be greater during this stage than the other three stages. Numerous wells would have to be drilled, and each would have to be tested prior to being put into production.

To determine flow characteristics and to clean out the boring, each well would have to be vented to the atmosphere. The chemical constituents of the vapors vented to the atmosphere cannot be predetermined. Table 8 provides a comparison of gases associated with existing geothermal developments.

Table 8. Examples of gases associated with various geothermal systems in volume percent

	Geysers 1/ California	Larderello 1/ Italy	Matsukawa 2/ Japan	Namafjall 3/ Iceland
H_2O	98.045	98.08	99.87	99.43
CO_2	1.242	1.786	0.18	0.18
H2	0.287	0.037	0.01	0.19
CH_4	0.299			0.01
N_2	0.069	0.0105		0.05
A			0.03	
H_2S	0.033	0.049		0.14
NH_3	0.025	0.033		
H_3PO_4	0.0018	0.0075		

1/ "Vapor-Dominated Hydrothermal Systems Compared With Hot-Water Systems," by D.White, L.P.J. Muffler, A. Truesdell
2/ "The Geological Environment of Matsukawa Geothermal Area, Japan," by H. Nakamura, K. Sumi, K. Katagiri, T. Iwata
3/ Calculated from "The Use of Natural Steam in Diatomite Plant," by Lindal.

The concentrations of noxious gases are expected to be small and not considered harmful. As testing of the wells would last for relatively short periods, the total gaseous emission would be low. Because of the frequency of thermal inversions in the valley, releases of steam and gases during these periods could contribute to pollution buildups.

Operations: Non-condensable gases, such as hydrogen sulfide, carbon dioxide, ammonia would be concentrated at the power plant during the condensation of the steam. These gases would generally be ejected into the atmosphere. Water vapor would be vented from the cooling towers. During the winter months the water vaper may contribute to fogging. The effects of increased humidity is speculative. A reduction in winter temperatures is possible. If a temperature c change does occur (although minor) secondary impacts may occur to vegetation and wildlife.

New wells, pipelines, maintenance of facilities may also permit gases to escape. These impacts would be temporary.

Close-Out: Wells would be plugged and pipelines removed during this phase. Emissions from the geothermal system would cease. Particulate concentrations generated by equipment removing the facilities would be low.

Noise: Exploration - Some noise would be generated by aircraft used in airborne surveys (magnetometer, etc.) and by vehicles. Noise levels from truck mounted portable drill rigs (used in drilling thermal gradient and seismograph holes) would have a low intensity with negligible impacts on the environment. Larger rigs may be used for test borings. These rigs would be "conventional oil field type" rotary rigs. Noise would be generated by diesel engines and the handling of pipes, casings etc.

Mud is generally used as the circulatory medium in drilling. Where water flows are not encountered, eompressed air may be substituted as the circulatory medium. At the Geysers dry steam field in California, mud is used to the depth where temperature interferes with proper operations, then compressed air is used. Noise created during the air drilling operation is intense and approximately that of an unmuffled diesel truck.

To determine the flow characteristics of well, venting is required. High noise levels would accompany this operation.

Development: Noise levels during this phase would be greater than during exploration because of the increased number of wells being drilled and tested. After initial testing, wells would be capped and with the use of mufflers noise would be of low intensity. During operations ambient noise levels would be raised to a level of annoyance for human or animals

within 500 feet and would be noticeable for over one-quarter mile.

A complete discussion of noise associated with geothermal development is provided in the Final Environmental Statement on the Geothermal Leasing Program (Chapter III). Table 9 excerpted from that document, provides comparative levels from selected operations.

Table 9: Comparison of noise levels between the Geysers Geothermal area and other noise sources:

Source	Level	Distance
The Geysers Area		
Drilling Operation (air)	126 dba	25 feet
Drilling Operation (air)	55 dba	1,500 feet
Muffled testing well	100 dba	25 feet
Muffled testing well	65 dba	1,500 feet
Steam line vent	100 dba	50 feet
Steam line vent	90 dba	250 feet
Comparative levels		
Jet aircraft takeoff	125 dba	200 feet
Threshold of pain	120 dba	
Unmuffled diesel truck	100 dba	50 feet
Street Corner in a large city	75 dba	
Residential area at night	40 dba	

dba: decibel value measured using the weighting network of a standardized sound level meter.

Because of the proximity of communities and dwellings to the KGRA and other proposed lease areas in Sevier Valley, noise will be an adverse impact.

Operations: The potential for hugh noise levels exists if steam lines or wells should break. However, this would be of short duration until repairs could be completed. During operations considerable noise may occur whenever expanding steam is released. At discharge points where waste water issues from steam - water separators, the residual steam contained in the waste fluid will escape with a loud rumble. Noise produced from the geothermal complex would be continuous and thus adversely impact man and animals within the distances cited above.

Close-out: Noise generated during this phase would be by machinery used in removal of equipment and rehabilitation. Noise generated would be less than described under previous phases.

Land

Exploration: The impacts of exploration would range from negligible to high. A high potential for erosion exists after destruction of the protective vegetal cover during the construction of access roads, trails, drill pads, and by off-road vehicles. Roads and trails constructed upon steep mountain slopes are particularly susceptible to erosion.

The soil structure could be temporarily altered by off-road vehicle use, and might be permanently disturbed by road and trail construction.

Re-vegetation tends to be extremely slow, and the initial flora established usually are undesirable species (halogeton, russian thistle, etc.) On some abandoned roads or other rights-of-way, native vegetation has not been completely re-established for over 30 years.

Sterile drill cuttings, drilling mud, and chemicals associated with drilling may be potential sources for soil pollution at the drill sites.

Roads and drill pads bulldozed on the steep hillsides may be subjected to erosion. Without control measures erosion could add to the sediment load in local drainages and irrigation systems.

Development: The impacts on the land during development would essentially be the same as those during exploration though greatly magnified. Less disturbance from off-road vehicle use would result, but construction of permanent roads, power plants, pipelines, power lines, and cooling and settling ponds will alter soil structure, depth, and nutrient properties over large areas, and could have long term impacts for land uses except those related to the geothermal development.

Intensive disturbance during construction will present the opportunity for localized wind and water erosion to have a significant impact.

The expected impacts on geologic structure would be:

(1) The drill holes themselves, impacts would be negligible.

(2) Fracturing, and other techniques required to bring the well into production, impacts would be negligible.

(3) Possible loss of porosity and permeability in the geothermal producing zone due to withdrawal of fluids and resulting consolidation of the aquifer materials. Impacts would primarily be on the life of the field and cannot be ascertained at this time due to insufficient data.

During production testing and development of the geothermal field, disposal of brines may increase the concentration of salts in local soils, particularly if holding ponds are used. Eventually these salts could be leached from the sites but because of low annual precipitation in the Monroe-Joseph Geothermal area leaching would take many years. If injection wells are utilized the probability of direct contamination of soils would be reduced. Indirect sources of soil contamination from brines will be analyzed in the water section of this document.

High voltage power transmission lines leading from the power plant sites would have to be constructed during this stage. Impacts of these lines cannot be evaluated at this time as routes are not known. Individual EAR's (Environmental Analysis Record) or EIS's (Environmental Impact Statements) would be prepared to assess their impacts before rights-of-way are granted.

Figure 8 identified proposed routes for I-70 and a 230 KV transmission line through Sevier Valley. Both routes are within proposed lease areas. The latter (transmission line) bisects the Monroe segment of the KGRA. The conflict or compatability of the geothermal development with these two proposed land uses cannot be fully evaluated at this time because specific locations of geothermal activities are unknown.

It is estimated (based on Cerro Prieto data) that each power plant and associated producing wells, pipeline, etc. could use up to 800 acres of land. Such surface modifications would represent a decided change in land use, but not necessarily a severe impact.

Operations: Development of additional wells and accessory pipelines would continue during the "operations phase". The surface disturbance would be similar, but less extensive, to impacts described previously.

Disposal of waste waters into evaporation ponds, during testing of new wells, could pollute soils adjacent to the ponds. The principal environmental impacts which may occur in the Sevier Valley area are land subsidence and the possibility of inducing seismic activity. Whenever fluids are

extracted from a ground water reservoir - that is, withdrawals exceed the recharge and the reservoir pressures continue to decline--land subsidence may occur. Throughout much of the developed area of the Valley, subsidence could cause costly damages, mainly through change of grade of irrigation canals and drain ditches, and through change of slope of farm lands and underground tile drains, both of which are laid to specific grades. In outlying developed areas subsidence might be tolerated. In either setting, the likelihood of subsidence resulting from the extraction of reservoir fluids must be fully considered. The hydrogeologic parameters affecting the magnitude, extent, and rate of subsidence should be understood. Subsidence results from the compaction of compressible beds of the aquifer system as effective stresses are increased by fluid-pressure reduction. The magnitude of this subsidence is dependent on the effective stress increase caused by the pressure drop, the compressibility of the deposits, the thickness of the compressible beds, the time the increased stress has been applied and also on the past stress history--whether the increased stress is being applied for the first time or has been attained or exceeded previously. Although a small part of the subsidence may be elastic in nature and tend to rebound when the stress is removed, most of the change is nonelastic and nonrecoverable.

Land subsidence caused by the exploitation of oil and gas resources and intensive pumping of ground water is relatively common throughout the world. Recently subsidence has been related to the extraction of geothermal waters at Wairakei, New Zealand, and Cerro Prieto, Mexico. Although the geologic setting of these locations differs considerably, the basic cause of subsidence is the same-the reduction of fluid pressure causing a marked increase in effective stress.

At Cerro Prieto, subsidence has been measured 7 miles outside the well field even before the beginning of extensive production. It is reported that the subsidence there is as much as 7 inches to date. Corresponding effects could occur in the Monroe-Joseph Geothermal area unless provisions are made to maintain reservoir pressures. As in oil-field or artesian ground-water production a direct relation exists between subsidence and fluid-pressure decline in a geothermal field. Subsidence can be minimized or prevented by maintaining fluid pressures by either natural or artificial recharge.

Another potential environmental impact that requires consideration in Sevier Valley area is increased seismicity induced by geothermal development. The area is traversed by active faults.

Experience in other areas indicates that increased seismic activity, in the form of swarms of micro-earthquakes, has occurred as a result of fluid injection into confined systems. Similarly, heavy production of fluids from confined systems, which causes land subsidence, has also been related to tectonic activity, such as displacement on fault surfaces as the confined system readjusts to changing stress.

A potentially serious impact associated with the field development stage involves the risk of triggering a damaging earthquake by changing the pore pressure in an active fault zone due to injection or withdrawal of large volumes of fluid. Earthquakes have been clearly linked to the injection of fluid in wells at the Rocky Mountain Arsenal near Denver, Colorado, and the Rangely oil field in northwestern Colorado. In both cases evidence suggests that the reservoir rocks were under substantial tectonic shear stress--a situation that exists in the KGRA of the Sevier Valley. In the Denver series, earthquakes with magnitudes up to 5-1/2 were triggered at distances of several miles from the base of the injection well. Earthquakes have also been triggered by the withdrawal of large volumes of fluid. In the case of the Wilmington oil field near Long Beach, California, the earthquakes were apparently associated with large scale subsidence.

It is difficult to assess the extent of this hazard in the proposed lease area. Massive reinjection, as would be necessary for full development of the geothermal resources has never been attempted, especially in an area of known high seismic activity. If one could guarantee that the fluid produced would be returned to its source volume, one could reasonably infer a low probability of triggering earthquakes. But reinjection unavoidably will be away from the exact production area, and accordingly there will be a finite but uncertain probability of increasing the pore fluid pressure of rocks already under stress which could be conducive to triggering a potentially damaging earthquake.

It is not felt that microearthquakes related to subsidence are likely to be significant in the development of the geothermal fields in the Valley. Significant subsidence could be costly or even intolerable in the Sevier Valley from a point of view of land configuration and land use.

Close-out: It is probable that abandonment of a geothermal power plant would take place gradually, as presuures, and geothermal fluids in the field are depleted, rather than in the short, well defined time frame generally associated with the dismantling of an industrial facility such as a manufacturing plant or smelter. Abandonment does not

necessarily imply that physical plant facilities would be completely removed as other suitable and compatible economic uses may be found for these facilities. Because geothermal development has been limited and cases of abandonment are lacking, impacts on land and land use are unknown. It is assumed that this would be a period rehabilitation and reclamation.

Water

Exploration: There are several perennial and numerous intermittent streams in the area. Disturbance of the soil by off-road vehicles, road and trail construction, and drill site construction would contribute to an increased sediment load when adjacent to running streams. Drill cuttings and drilling mud discharged onto the surface or into a mud pit have the potential for adding to sediment load.

Exploratory drilling or the use of explosives in seismographic surveys could affect the flows of cold springs - that originate within the proposed lease area. Although the hot springs (Monroe & Joseph) are located on private lands drilling on adjoining leaseable lands may alter flows of these hot springs.

Development: Activities during this stage would repeat those impacts identified above, and also add a new dimension, chemical pollution of waters caused by discharge of brines. The possibility of spilling quantities of brines at the land surface, or from blowouts in wells could occur at this stage or during operations. This would release quantities of brines into parts of the aquifer system other than those from which the brines originated. Ponds and well heads are potential sources of spills that could result in the application of quantities of saline water at the surface that would be the detriment of other uses of the soil. Infiltration could degrade ground water at the water table. As shown in Table 3, soils in the Monroe-Joseph Geothermal area have moderate to rapid permeability, this would increase the probability of discharged fluids entering the ground water. In the discussion of the local hydrologic cycle (B.5.a) it was noted that 50 percent of river diversion reappears as surface water for rediversion downstream. Because of this return rate, it may be anticipated that brine discharges would be cycled into the Sevier River flow. This would increase the dissolved solids and could affect local as well as downstream irrigation.

Subsurface leakage due to blowouts and casing failures could result in injection of hot water into zones of cooler and less saline water. Subsurface injection may not be critical

because the receiving water may not be suitable for most uses. If injected into an aquifer containing lower concentrations, the quality of ground water for cooling or other uses could be rendered unsuitable.

Temperature contamination of existing surface waters by hotter waters produced from geothermal wells would have major impacts on flora and fauna. Many aquatic plant and animal species are viable only within limited environmental conditions. Discharge of heated or super heated waters into existing surface water could raise water temperatures beyond the tolerance of indigenous flora and fauna.

Anticipated Impacts On Living Components

Vegetation: To delineate the types of vegetation that may be impacted the reader should examine Figure 1 (map of the proposed lease areas) and compare it to the vegetative type map, Fig. 9. The analysis below will focus on what impacts may be anticipated

Exploration: Airborne operations during exploration would have no significant impact on the vegetation. The impact of other operations would be very localized. Off-road vehicular travel would destroy some fragile broad leaved plants. Road and trail construction and drilling operations would result in removal of vegetation from the roadway or drilling site.

Development: The impacts on vegetation of road construction and improvement, of drilling operations would be similar to that under exploration. Though drilling operations would involve a larger area during development than during exploration. They would be quite local.

An impact which would influence vegetation would occur if the water regime were disturbed. It is unknown whether tapping geothermal resources will influence surface water. It is possible that the flow of springs in the vicinity of a development could be reduced or stopped entirely. If this occurred the vegetation dependent on this water source would be reduced or eliminated.

Operations: Significant effects on vegetation of the operation of a power generating plant are problematical. It is likely, disposal of waste water would have significant impacts, depending upon the mode of disposal. Field crops may be impacted if irrigation water contain increased salt concentrations.

The evaporation of large quantities of water could alter the micro climate near the plant, making it more humid. This could result in establishment of plants better adapted to the increased moisture than the native desert type species. It may result in more vigorous and profuse growth of existing species.

Because each generating station with its support facilities (wells, pipelines and roads) may occupy up to 60 acres, this quantity of vegetation may be removed.

Close-Out: Cessation of surface usage would permit the re-establishment of flora. If revegative programs were not undertaken plants low on the succession scale, such as halogeten would invade.

Animals: To determine which wildlife species are within the proposed lease area Table 7 and Figures 1 & 9 should be reviewed.

Wildlife

Exploration: Because discrete operations during this phase are small scale, the loss of wildlife habitat will be minor and highly localized. Disturbance or harassment by aircraft and off-road vehicles may be expected.

Development: Test drilling and production testing of geothermal steam resources in the proposed geothermal lease areas could have varied impacts upon fish and wildlife. Most impacts would occur on or adjacent to well sites, although water quality impacts potentially could have far reaching effects. The magnitude of particular impacts would depend upon the extent and duration of the geothermal development operations, and the effectiveness of control measures to mitigate or avoid adverse environmental impacts. Where vegetative cover is removed habitat would be disturbed or lost during the period of operation. Revegetation and natural growth would restore the area's production after geothermal activities have ended.

Animals displaced due to habitat changes may not be able to move to other areas and survive if these areas already are filled to capacity. By contrast the clearing of Pinyon-Juniper and subsequent revegetation could result in improved habitat for some species. The greatest impact will be on the small species such as mice, moles, and kangaroo rats. Squirrels and rabbits could be affected, but to a lesser extent. Species with larger home ranges (such as coyotes, mule deer, and bobcats) would be seasonally affected. Predator species could be affected if their prey is reduced by a significant amount.

Drilling in riparian and meadow habitat could have an adverse impact on both terrestrial and aquatic habitat areas. Any development that would affect the quantity and quality of water could affect wildlife. Contamination of aquatic habitats in the perennial creeks, or the Sevier River could occur from discharges of geothermal fluids on the surface or into groundwater. If the geothermal fluids have low dissolved mineral contents, the impact would not be as significant as a concentrated brine. The geothermal fluids could contain dangerous trace elements such as arsenic, boron, and flouride. Additions of toxic concentrations of such substances into the streams in the area could seriously impact the aquatic and terrestrial life. Accidental release of geothermal fluids might create temperatures intolerable to some aquatic species and stimulate growth of nuisance algae.

The development of sump ponds could have hazardous or beneficial impacts upon fish and wildlife resources depending upon site factors. For example, if the produced water was of acceptable quality, benefits could occur in the form of increased nesting and feeding areas for waterfowl, shore and marsh birds. On the other hand, pond water containing toxic concentractions of trace elements could result in adverse effects on these birds. In addition to land modification, noise and human disturbance could have displacement

effects upon certain animals and birds in the site vicinity.

If erosion should result from geothermal activities, there would be added siltation of aquatic habitat within the area of project influence. The threat of siltation would be most severe during development and construction phases, although some could occur during the operational stages. Siltation could result in the degradation of fish spawning habitat and production of food organisms for fish. The degree of damage to aquatic habitat would be dependent upon the adequacy of erosion control measures.

Impacts on the deer herd that migrate into the proposed lease areas during the winter may be significant. The lower slopes (primarily national resource lands) are the crucial winter deer range.

Operation: Full field development and operation of the power generating stations could have a major impact on wildlife resources in the area. The impacts described under "development phase" could be magnified. Loss of habitat due to disturbance of vegetation may result in local changes in species density and composition. Predator-prey relationships may be disrupted and food chain and food webs altered in the ecosystem. Loss of habitat also may result from indirect effects, such as noise and human disturbance.

Reinjection of mineralized geothermal fluids, if not properly accomplished, could cause pollution of the aquifers that charge the various aquatic systems in the area. Changes in water quality and thermal balances in these systems could result in major impacts to the terrestrial and aquatic organisms that depend on the system for their survival.

Additional power transmission systems in the valley may increase the raptor electrocutions, unless structures are designed to mitigate this hazard.

Close-out: Re-establishment of fauna would be dependent on habitat improvement measures incorporated into the close-out of operations.

Livestock

If geothermal activities (exploration, development and field operation) occur in areas with existing allotments, impacts will occur to livestock. These impacts will be from the loss of forage and possible contamination or damage to water systems. Current stocking rates may need to be adjusted because of the AUM's loss.

Anticipated Impacts on Ecological Interrelationships

Ecological impacts have been recognized throughout the previous sections of this analysis. The following discussion summarizes the interrelationships that were established during analysis of the non-living and living components.

In those areas where the vegetation is destroyed, the ecological interrelationships will be disrupted. The plants are the base of the food chain and without them, the herbivores will concentrate in areas where forage is available. Predators will also shift location if they are to survive.

Human activity will modify the activities of the native fauna in areas adjacent to any activity site.

The ecological impacts will vary from high locally to insignificant from the standpoint of a general overview due to the widespread occurrence of that community type.

Disposal of brines may contaminate soils and/or ground water. This will have secondary impacts on other components of the ecosystem.

Alteration of water temperatures may eliminate certain aquatic species and promote algae growths.

Moisture relationships will change near the power plant site because of increased humidity. The ecosystem may be changed on a microscale.

Anticipated Impacts on Human Values

Landscape Character

The disturbances caused by implementing the proposed action will be highly visible because leasable lands are located on the hillsides of both sides of the valley. Terrain scarred by roads, drill pads, pipelines, transmission lines and power plants will be slow to heal and scars may be considered as permanent features on the landscape.

These features will be in sharp contrast to existing landscape elements.

Scientific and Educational: (i) Archaeological. Table 10 indicates which values may be impacted, and the probable degree of impact. It is expected that few large, permanent sites are located within the KGRA. What sites may exist will be located along the Sevier River. The KGRA does contain numerous smaller chipping stations and temporary encampements at higher elevations along the eastern boundary.

Table 10. Expected Impacts on Archeological Values

Site	Site Type	Location	Expected Impact
42 SV 612	Petroglyph	Foothill	Low
42 SV 613	Petroglyph	Foothill	Low
42 SV 614	Chipping Station	Foothill	Medium
42 SV 615	Petroglyph	Foothill	Low
42 SV 616	Petroglyph	Valley	Low
42 SV 617	Chipping Station	Valley	Medium
42 SV 618	Chipping Station	Foothill	Medium
42 SV 619	Petroglyph	Foothill	Low
42 SV 621	Chipping Station	Foothill	Medium
42 SV 622	Chipping Station	Foothill	Medium
42 SV 623	Chipping Station	Mountain KGRA	High
42 SV 624	Chipping Station	Mountain KGRA	High
42 SV 625	Encampment	Mountain KGRA	High
42 SV 626	Chipping Station	Mountain KGRA	High
42 SV 627	Chipping Station	Mountain KGRA	High
42 SV 628	Chipping Station	Mountain KGRA	High
42 SV 629	Chipping Station	Mountain KGRA	High
42 SV 630	Chipping Station	Foothill KGRA	High
42 SV 457	Petroglyph	Foothill	Low
42 SV 611	Chipping Station	Foothill	Medium

Larger permanent sites are probably located throughout the valley bottom. Many of these sites would be located on private lands. Numerous smaller sites included petroglyphs are found along the foothills. The latter may be within the potential impact zones.

Impacts to these values may occur during any phase of the proposed activities associated with geothermal development.

(ii) Educational: Geothermal resources and development are not widely understood by the public. Development in this Sevier Valley would provide a unique opportunity for students, tourists and the general public to learn of this energy source.

Socio-Economic

There are several ways to view the economic implications of geothermal development:

Direct revenues
Indirect revenues
Direct expenditures
Indirect expenditures

Direct Revenues

Lease rentals and royalties are distributed as follows:

(1) Rentals - Each lease brings in $1/acre per year annual rental (minimum) which increases on a graduated basis after the fifth year.

(2) Royalties - When production is reached, royalties of 10-15% of the value of the steam are assessed. Royalties up to 5% are also paid on by-product minerals, including commercial demineralized water.

At the Geysers, a royalty of 10% of the steam value is paid to private landowners. The royalty averages about $250,000 per year per 100 MW plant. With 400 MW capacity, the royalty is about 1 million dollars per year from a production area about two miles wide by seven miles long.

(3) Bonus Bids - On competitive lease sales, bonus bids are an additional source of revenue. In the first federal lease sale held in California on January 22, 1974, twenty leasing units were bid on, with 57 bids totalling $12-1/2 million. The highest bid for a single leasing unit was $3,200,000, which amounts to $1,367.50 per acre for the 2,340 acre unit.

Indirect Revenues

Taxation by State and local subdivisions accounts for an additional increment of revenue. Taxes paid to Sonoma Co. from the Geysers approximate $1 million per year for the current 400 MW capacity.

Dr. Robert W. Rex, President of Republic Geothermal Inc., in remarks to the Sub-Committee on Energy, Committee on Science and Astronautics, U. S. House of Representatives, on September 18, 1973, said in part "...Every 1000 megawatts of geothermal development on Federal lands yield about $1 billion of public revenue; 73% to the Federal government, 11% to State governments which have income taxes... and 18% to County governments.

Direct Expenditures

Development of a 110 MW plant costs $15-17.5 million at the Geysers. Individual wells cost about $150,000-$200,000 each.

Indirect Expenditures

The local business community will be affected by geothermal development, both by increased business and by having to provide additional services.

During exploration drilling, two drilling rigs might be used for 1-2 years. Employees would consist of about 40 people directly involved in drilling, with 10-20 additional service people intermittently involved.

Development would advance in 55-110 MW increments in an orderly

fashion over a period of 2-10 years. Drill crews for 2-3 rigs would number 40-60, and 20-30 additional people would be involved in plant construction. All of the above personnel would be temporary.

Once the field is operating on stream, about five (5) permanent employees are needed for field production plus five (5) more for each 110 MW plant. One drilling rig would be needed full time, adding 20 more permanent employees to the area.

Thus, for several years, a local community would be burdened with providing necessary school and service facilities for between 40 and 90 additional temporary families. Thereafter, 30 or more families would become permanent residents, also requiring services.

In the short run, communities near a geothermal development would be financially strained. However, such development is capital intensive and in a few years the increased tax base should be much greater than community expenditure on a per capita basis of additional residents.

The influx of population, particularly if multiple generating units are developed, would change the life style of smaller communities in Sevier Valley.

b. Possible Mitigating or Enhancing Measures

Environmental Controls

Geothermal energy development is subject to a wide variety of environmental controls under the authorities of two agencies--Geological Survey and BLM. Such environmental controls are covered in the regulations of both agencies (GS - 30 CFR 270; BLM - 43 CFR 3200) and are part of the exploration form (3200-9) and lease form (3200-21). Additional controls in the form of special stipulations, geothermal resources operational orders (GRO orders), and approved operational plans may also be used. Bonding is required to assure compliance.

Basically, the two agencies consult throughout the leasing program and agree on any needed special stipulations. For all actions up to and including issuance of a lease, the BLM is the responsible agency. For all operational activities undertaken after a lease has been issued, the Geological Survey is the responsible agency.

Opportunities to attach special environmental controls occur at several points:

Notice of Intent to Conduct Geothermal Resource Explorations - Form 3200-9) This form is filed for exploration activities not connected with a lease. The BLM District Manager has 30 days to either approve or disapprove the permit. Special stipulations may be added if needed. The Geological Survey will advise of any recommended stipulations to protect sub-surface resource values. A $5,000 compliance bond is required.

Proposed Plan - Prior to the issuance of a lease, the applicant must file a proposed plan detailing his proposed methods for diligent exploration. Environmental protection measures proposed are included. The proposed plan may alert the District Manager to special problems that should be covered by special stipulations in the lease. The Geological Survey will also review these plans and may furnish additional comments or information which may be useful for environmental considerations.

However, these proposed plans are filed so early in the process that they will generally be based on little knowledge of the available geothermal resource and, hence, will usually undergo major changes as new exploration data is gathered. They will tend to be written in broad general terms commensurate with the limited data available. Therefore, they cannot be entirely relied upon in anticipating environmental effects.

The chief value of the proposed plan is to commit the applicant to a program of diligent exploration. Reliable environmental judgments can be made later when an actual plan of operation is filed.

Leases - Lessees are committed to a variety of environmental controls by regulation and the standard lease (Form 3200-21) contains stipulations on protection of the environment and antiquities.

Additionally, special stipulations may be added if necessary. The Geological Survey will provide advice as to recommended special stipulations to protect the subsurface environment and as to the effect of any proposed BLM special stipulations on geothermal development.

Two bonds are required: a $10,000 bond to insure lease compliance, and a $5,000 bond to indemnify any damages to persons or property. A $150,000 nationwide bond or $50,000 Statewide bond may be substituted.

Geothermal Resources Operational Order (GRO Order)- The Geological Survey issues GRO orders which set forth the requirements and procedures to be followed within a particular region or area. This allows flexibility to address conditions which vary widely from area to area. The BLM District will be consulted by Geological Survey to develop any needed surface resource protection requirements.

Plan of Operation - Before any operations may commence on a lease, the lessee must submit a detailed plan of operation and gain approval of it. Both the Geological Survey and the BLM must approve it.

In practice, these plans will tend to be incremental with new phases of the plan based on information gained in the preceding phase. They will be detailed enough to allow a sound environmental assessment prior to approval.

Specific mitigating measures are outlined in the following section "Recommendations for Mitigation or Enhancement".

c. Recommendations for Mitigation or Enhancement

General

1. Protection of archaeological values. In Utah, as in other arid lands, archaeological values tend to be located in the vicinity of available surface waters.

   Although a preliminary survey was made for this analysis, an archaeological investigation should be required for all sites and areas upon which the surface will be disturbed (constructed roads, drill sites, waste disposal ponds, powerline tower or pole sites, pipeline rights-of-way, building sites, actual power plant locations, gravel pits and/or quarries and any area to be graded, graveled or paved).

2. Soil and Vegetative Protection and Restoration. Whenever possible, existing roads and road rights-of-way should be utilized. New road construction and re-construction should be cleared with the surface management agency 30 days prior to commencing construction.

3. Temporary roads should be built with as little soil and vegetative cover disturbance as possible. "Dropping the blade" clearing of temporary roads should not be permitted unless prior clearance is obtained.

4. Clearing, for drill sites should be limited to minimum size practical for operations.

5. If leveling is required on drill sites, top soil should be stripped and stockpiled for respreading upon abandonment of temporary drill sites, and use in rehabilitation of excess area needed for drilling, but not required for operation of wells. Stockpile topsoil for rehabilitation of reserve pits, temporary access roads and other disturbed areas.

6. Upon abandonment of roads, drill sites, etc., compacted areas should be water-barred, scarified and reseeded. Reseeding should be done with the plant species and at the times of year specified by the Surface Management Agency.

7. Off-road vehicle travel should be restricted in the spring or after heavy rainfall when the soils are wet and muddy. Off-road travel should be held to an absolute minimum.

8. All machinery and test wells should be equipped with appropriate mufflers to meet current noise contamination standards.

Exploration

The items noted under Mitigating Measures, General, are included here by reference.

Development

The items noted under Mitigating Measures, General, are included here by reference.

1. Roads. Provision should be made for control of particulate matter (dust) by watering or other acceptable means during periods of heavy use to meet air quality standards.

2. Permanent work areas around wells should be graveled to prevent erosion and production of particulate matter (dust). Permanent access roads should be graveled or paved.

3. Consideration should be given to landscaping of power plants, pipelines, and well heads to minimize visual impacts. Color of power plants, pipelines, etc. should be chosen, where practicable, to blend with the existing environment.

4. Steps should be taken to prevent electrocution of eagles, hawks, and other birds in designing electric transmission lines, substations, and other electrical power facilities. REA standards would be the minimum acceptable.

5. Disposal of geothermal fluids produced during testing of wells should be handled so as not to contaminate surface waters.

6. After completion of drilling, sumps should be cleaned out, backfilled and restored rather than fenced and allowed to dry out. Waste material shall be disposed of as agreed to by the surface protection agency.

7. Design and location of cooling ponds should be approved by the Surface Management Agency.

8. Plant sites should be fenced so as to provide protection for livestock and wildlife.

Operations

General and development mitigating measures are included here by reference.

1. New Drill Sites. These measures will be the same as for drill site development under the development phase.

2. Waste Disposal.

   a. Evaporation (cooling) ponds. If the water quality is good, steps should be taken to utilize the waters in a manner beneficial to wildlife and livestock. If the waters are toxic, steps should be taken to prevent poisoning of wildlife, livestock and humans.

   b. Reinjection. Care should be taken to prevent contamination of aquifers which are used, or have potential for, water supply.

Abandonment

Abandonment of a geothermal field and removal of plant and surface equipment would occur over a long period of time as the field depletes. A restoration and reclamation plan spelling out generalized mitigating measures should be required prior to issuance of permits to proceed with construction of facilities. Requirements for restoration and reclamation would be varied dependent on the individual site.

d. Residual Impacts

Rules and regulations, lease provisions, and general resource operational orders are designed to assure that geothermal resources can be developed and utilized in an environmentally acceptable manner. In those instances where this cannot be done, development and use will not be permitted. However, virtually any human use of lands and their resources may have some degree of adverse impact. Where benefits warrant acceptance of such impacts, such uses may be appropriate provided the adverse impacts have been adequately recognized, mitigated to the extent possible, and are not so serious as to preclude the proposed action. The following discussion summarizes residual impacts that may be unavoidable, should the proposed leasing of lands in Monroe-Joseph Geothermal Area be implemented.

1. Vehicle travel will result in dust, exhaust gasses, noise, disturbance of wildlife, injury or killing of wildlife, accidents, etc. When existing roads are used, such impacts would be nominal since they primarily would be the result of increased traffic. Advance approval will be required for construction of new roads or trails to assure proper construction and restoration, but impacts will result from vegetation removal and soil movement, even though adequate mitigating measures are taken. There will be a certain amount of disturbance of vegetative cover and soil surface from cross-country travel on roads or trails that can have temporary impacts until cover is restored and the soil is stabilized. Evidence of such roads or trails may remain for several years which could be conducive to casual use by others that could result in damage. Failure

to comply with regulations or exploration stipulations could result in similar impacts, but damages could be more significant, particularly if such improper use was not promptly corrected.

2. Drilling of shallow holes or blasting may be necessary which may result in minor vegetative and surface disturbance in the immediate area of activity. All drill holes will be small and shallow and are to be capped when not in use so no damage is anticipated from such holes. If not capped, small animals could fall into the holes and perish. Large animals or man could step in open holes and be injured.

3. Exploration of geothermal resources will have some residual impacts upon the vegetal communities within the area. The impacts, of course, will vary depending upon the nature of activities and composition of the vegetal community.

Development

Heavy equipment capable of drilling to depths of several thousand feet would be required. The enlargement and improvement of existing roads or construction of new roads to provide access for drilling equipment and supplies to the drilling site would involve unavoidable impacts from vegetative cover removal and surface disturbance. At each drilling site a level area of approximately one to two acres is required for drilling operations. While compliance with lease and GRO Orders will prevent serious impacts some minor impacts still will result. Most of the potential adverse impacts listed under exploration could be expected with some intensification in areas of heavy activity.

During drilling operations, moderate levels of noise from equipment operations would be unavoidable. Even where special noise control measures are required, noise levels will be above natural levels.

Physical land modification will increase at this stage which could result in loss of wildlife forage and wildlife values in the areas of operation. Such impacts generally would be of a temporary nature. There could be some reduction of public use of areas for recreation, hunting, etc. during periods of test drilling activities to protect equipment and facilities, and to reduce hazards to the public. Surface disturbance scars would be larger and possibly permanent in nature.

Well blowouts could result in venting of steam, associated gasses and saline water into the atmosphere, ground area and surface water, creating air and water contamination as well as high noise levels and exposing individuals to possible injury.

Adverse impacts would continue until the blowout is controlled. The seriousness of the incident could range from minor to serious, depending upon location.

In the event of an accidental discharge of geothermal brines at land surface in the valley, the brine will almost inevitably flow to the Sevier River, thereby increasing the dissolved salts in the river with potential impacts as previously described. The impact of degradation of surface water quality in any part of the proposed lease area would affect terrestrial and aquatic life. Salt concentrations in soil would also be increased.

In a hot-water dominated reservoir, production testing requires production of the formation fluid over an extended period. Disposal of produced brine would have an environmental impact released to the surface environment as discussed above. Large volumes of liquids could be involved. If not properly contained or reinjected, they could seriously impact on surface water quality and related fish, wildlife, or other water-related values.

Operation

Full-scale operation will require complete development of well and steam transmission systems, power generation facilities, brine disposal facilities, transmission lines, permanent roads, etc. Many of the potential unavoidable adverse impacts associated with exploration and testing will no longer exist but other impacts may increase in proportion to the scale of development. Each well will involve clearing, grading, and improvements. Steam pipelines connecting wells to the generators likewise require clearing and grading. During construction there will be considerable activity, noise, movement of earth, dust, etc. After construction is completed and all necessary environmental protection measures are taken, the nature of the site will be changed from its former state to an industrial complex. Cleared areas, buildings, powerlines, brine ponds, etc. will represent permanent changes in the landscape.

Even with adequate controls, full scale operations will involve higher than natural noise levels, emission of steam and other gases to the atmosphere, disturbance from operational activities, additional vehicle traffic, etc. Transmission lines will be a hazard to some wildlife as they may result in minor levels of electrocution of eagles, hawks, and other birds. Transmission lines damaged from storms or other failures can result in personal injury but to no greater extent than lines built in connection with other power systems under similar conditions.

Potential adverse impacts would be introduced during full scale operation from possible land subsidence or increased seismic activity. However, a significant impact from these causes would not be expected until major production begins and appropriate mitigating measures would be taken as soon as monitoring indicates a need for such actions.

If reinjection of wastes does not successfully maintain fluid pressures in the geothermal aquifer system where extractions are undertaken, some subsidence can be expected even if operations are discontinued.

The impacts of land subsidence and seismic activity will be mainly on structures - well casings, pipelines, canals, drainage systems, buildings, etc. Operations could have some unavoidable adverse impacts similar to those previously described on land, vegetation and associated aquatic and wildlife populations in the immediate vicinity of the wells, islands and/or drilling platforms, pipelines, generating plants, cooling facilities, powerlines, pondage areas, recharge pipes, the associated work areas and roads, and buffer areas around the developments.

Some of the potential adverse effects on land use, natural values and aesthetics as discussed in previous chapters would occur. Though noise and gas emissions can perhaps be limited or avoided, little can be done to prevent the change from a wide open natural setting to a partial industrial complex. There would be some reduction in outdoor leisure activities in the leased areas.

2. RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

Development of the geothermal resource potential in the Monroe-Joseph Area would tap a previously unused natural resource to supplement and replace energy sources now used to supply the existing and future demands of the nation. The leasing of lands for geothermal development would involve commitment of a portion of the available resources of land, water and air of the acreage involved. The lifetime of the potential energy sources cannot be predicted accurately, though lifespans in excess of 30 years may be considered reasonable. (Larderello Field in Italy has been in continuous production since 1905). It is possible that as technology develops these potential sources of energy could have their lifespan extended.

At some time in the future these sources would no longer prove economic. At that time, the leases would terminate, facilities would be dismantled and the land restored as much as may be practicable. The combination of reclamation and restoration, plus natural vegetation recovery should result in reversion to a natural condition similar to that prior to commencement of operations. At the present time a majority of the national resource lands are limited in their productivity from the standpoints of agriculture, wildlife, etc., because of insufficient rainfall.

3. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Depletion of water from the geothermal reservoir would be a significant commitment of resources.

Consolidation of aquifers in the geothermal reservoir, and the land subsidence and changes in surface drainage patterns, etc. that may result from removal of fluids from the geothermal reservoir.

Permanent scarring of the landscape resultant from construction activities.

ANALYSIS OF ALTERNATIVE NO. 1 (Do Not Allow Leasing)

1. Environmental Impacts of the Alternative

a. Anticipated Impacts

This alternative would involve an administrative decision by the Department of the Interior. The impacts of Alternative #1 are as follows:

A decision not to lease could seriously hamper development of the resource. Orderly and efficient development of federal lands and private lands will require that the geothermal resource areas be developed as a unit rather than piecemeal if the best interests of the government and the private land owners are to be served.

Alteration of the existing environment would occur to a significant degree on private lands whether or not leasing of national resource lands takes place. Significant geothermal development may occur on the private lands that have already been leased.

Some domestic energy sources will have to be developed whether or not leasing of federally owned geothermal resource occurs. At best, the decision not to lease could be considered a poor trade, as geothermal energy has the potential for having less environmental impacts than the development of other energy sources. (For a complete discussion of these energy alternatives see "Final Environmental Statement for the Geothermal Leasing Program", U.S. Department of the Interior, 1973).

b. Possible Mitigating or Enhancing Measures

None

c. Recommendation for Mitigation or Enhancement

None

d. Residual Impacts

Same as "a" above.

2. Relationship Between Short-Term Use and Long-Term Productivity

Productivity of the public lands would remain unchanged because geothermal leasing and development would be excluded.

3. Irreversible and Irretrievable Commitment of Resources

Resources on public lands in the Monroe-Joseph area would not be committed but energy resources may be exploited elsewhere as the nation attempts to fill its energy needs.

D. PERSONS, GROUPS AND GOVERNMENT AGENCIES CONSULTED

Agencies Consulted

U.S.D.A. Forest Service, Fishlake National Forest
U.S. Geological Survey, Denver and Salt Lake City
State Clearinghouse, State of Utah - Serves as an Environmental Coordinating Council for State Agencies.
State Historic Preservation Officer
Six County Economic Development
Environmental Protection Agency
U.S. Fish and Wildlife Service
Utah State Department of Highway
Utah Division of Wildlife Resources
Central Utah Education Services
U.S.D.A. Soil Conservation Service

Public Meetings

News releases were prepared for the following local and state newspapers: Richfield Reaper, Salina Sun, Deseret News and Salt Lake Tribune. KSVC Radio Richfield carried announcements of the public meeting for a one week period.

Individual letters were sent to persons, agencies, local elected representatives and groups (Appendix A) inviting them to the public meeting or to submit written comments to the Richfield District Office.

Forty (40) people (plus BLM Staff) attended the January 23, 1975 meeting. Environmental groups, industry, local elected officials, governmental agencies and individual citizens were represented.

BLM staff met with the Monroe Lions Club on February 26, 1975 to discuss proposed leasing and potential impacts. Twenty-one (21) persons attended the meeting.

E. INTENSITY OF PUBLIC INTEREST

Public interest concerning the proposed leasing and development of geothermal resources in Monroe-Joseph area could best be described as "curiosity" at the present time. Articles in newspapers, magazines and television news items have suggested geothermal resources may provide a relatively "clean" energy source for the future, but details are not well understood by the public.

Locally, most private lands have been leased south of Richfield for geothermal resources, and locally opposition has not been significant regarding the proposed leasing of federal lands. The developer of the Monroe Hot Springs has expressed concern that development may "dry up" the hot springs. Water from the springs are planned as an integral part of his resort development.

Division of Wildlife Resources has noted the potential loss of crucial deer winter range for the Monroe Mountain deer herd.

The representative from ISSUE (environmental group) indicated he was not opposed to geothermal development, but leasing should be delayed until test plants in other hot water geothermal areas have been evaluated.

Because specific locations for discrete operations could not be identified, the public expressed some desire to evaluate the environmental assessment of the detailed "Plan of Operation".

F. PARTICIPATING STAFF

Bureau of Land Management

Name	Title	Specialization
Rulon Duncan	Environmental Coordinator (Team Leader for EAR)	Climatology, Socio-Economic Planning
Elbert Lowry	Wildlife Specialist	Wildlife
Lloyd K. Schlappi	Reality Specialist	Land use
Paul G. Boos	Recreation Planner	Recreation Human Value
Steve Marcus	Geologist	Geology
Fred Hassien	Surface Protection	Rehabilitation
Dee Williamson	Geographer	Soils and Hydrology
Darwin Anderson	Area Manager	Range
LaMar Lindsay	Archaeologist	Archaeology

Forest Service

R. Brent Hanchett	Landscape Architect	Recreation Aesthetics
John R. Lowe	Minerals Specialist	Geology and Minerals
Coy G. Jemmett	Wildlife Biologist	Wildlife
Dee B. Thomas	Hydrologists	Soils and Watershed

U.S. Geological Survey

Gary L. Galyardt	Conservation Division Geologist	Geology

G. RECOMMENDATION ON ENVIRONMENTAL STATEMENT

Public notification and consultation has not generated controversy or major opposition to the proposed leasing. If leases are issued and exploratory work begins, local attitudes may change.

Impacts have been analyzed and mitigating measures were recommended. Surface disturbance, air pollution, noise, wildlife habitat loss, water quality degradation, land subsidence and seismic activity were listed as possible residual impacts to the physical and biological system. Economic, sociological and cultural implications were also stated. Depletion of water from the geothermal reservoir was identified as a possible irreversible commitment of resources, if development occurs.

Based on this analysis, an Environmental Impact Statement (EIS) is not recommended at this time.

H. SIGNATURES

Robert E. Duncan — 3/4/75
Environmental Coordinator (Team Leader) — Date

Marvin G. Anderson — 3/4/75
Area Manager — Date

Edward L. Fish — 3-4-75
Acting District Manager — Date

Mailing List
Geothermal Steam Public Meeting Set For January 23, 1975

Mr. Jack Moffitt
U.S.G.S.
125 South State Street
Salt Lake City, Utah 84111

U.S. Fisheries & Wildlife Services
Rm. 2215, 125 South State Street
Salt Lake City, Utah 84138

Supervisor Ralph Cisco
Fishlake National Forest
170 North Main Street
Richfield, Utah 84701

Mr. Clyde Larsen
Soil Conservation Service
55 South First East
Richfield, Utah 84701

Sierra Club
Southwestern Representative
2014 East Broadway, Rm. 212
Tucson, Arizona 85719

Norman Fuellenbach, Publisher
Richfield Reaper
Richfield, Utah 84701

Utah Division of Wildlife Resources
Regional Director
Price, Utah 84501

Mr. Marven Ogden, Area Agent
U.S.U. Extension Service
Federal Building
Richfield, Utah 84701

Mr. Bert Carlson
State Planning Coordinator
State Capitol Building
Salt Lake City, Utah 84104

Mr. Theodore H. Tuttle, Director
Utah Division of Parks & Recreation
1596 West North Temple
Salt Lake City, Utah 84116

State of Utah Dept. of Natural Resources
Gordon E. Harmston
225 State Capitol
Salt Lake City, Utah 84114

Utah Geologigal Assoc.
P.O. Box 1134
Salt Lake City, Utah 84111

Mountain States Resources
915 West 100 South
Salt Lake City, Utah 84104

Dewain Washburn
State Representative
Monroe, Utah 84754

Sevier County Commissioners
Ivan Mills, Chairman
Monroe, Utah 84754

Ron Heaton, Executive Director
Six-County Economic Dev. District
P.O. Box 78
Nephi, Utah 84648

Bernell Washburn, Director
Utah Wildlife Federation
37 North Fourth West
Richfield, Utah 84701

Elwood Morrell
Bicknell, Utah 84715

H. Wesley Cherry, Wildlife Rep.
State Advisory Board
167 North Second East
Salina, Utah 84654

ISSUE
c/o Lloyd Gordon, Exec. Director
P.O. Box 728
Cedar City, Utah 84720

Clifton R. Merritt
Director of Field Services
The Wilderness Society
Western Regional Office
4260 East Evans Avenue
Denver, Colorado 80222

Uintah Chapter-Sierra Club
1247 Wilmington Avenue
Salt Lake City, Utah 84106

Geothermal Steam Public Meeting Mailing List

Utah Audobon Society
Dr. Harold B. Lamb
1060 East 1st South
Salt Lake City, Utah 84102

Wasatch Mountain Club President
425 South 8 West
Salt Lake City, Utah 84104

Mr. Robert H. Hassell
Escalante Wilderness Committee
P.O. Box 437
Panguitch, Utah 84759

Utah Environment Center
1247 Wilmington Avenue
Salt Lake City, Utah 84106

Paul S. Rattle, Mgr.
Utah Mining Assoc.
Kearns Building
Salt Lake City, Utah 84101.

Jay Gardner, Chairman
Sevier County Industrial Dev.Com.
Richfield, Utah 84701

Utah Statewide Archeological Society
Dean Caldwell, President
4283 Bennion Road
Granger, Utah 84119

Harold Brewer, President
Sevier Valley Wildlife Assoc.
115 East 5th North
Richfield, Utah 84701

James G. Clawson
Radio Station KSVC
Richfield, Utah 84701

Glen Willardson, Manager
Garkane Power Association
Richfield, Utah 84701

Utah Tourist & Publicity Council
Southern Utah Area
Richfield, Utah 84701

R.H. Massey,Dist.Land Manager
Union Oil and Gas Div.
P.O. Box 3372
Durango, Colorado 84301

Jay F. Gardner
Utah Power and Light Co.
175 North Main Street
Richfield, Utah 84701

Courtney Larsen, Mayor
Salina City
Salina, Utah 84654

Charles R. Hansen, Director
Utah Division of State Lands
225 State Capitol Building
Salt LakeCity, Utah 84114

G. Standford Rees
State Senator
Gunnison, Utah 84634

Dan Thompson, Town President
Aurora, Utah 84620

Joseph Jorgensen, Town President
Sigurd, Utah 84657

Mayor Kendrick Hardard 251 North Fifth Wes
Richfield, Utah 84701

Norris Jensen, Mayor
Monroe, Utah 84754

Gerald Oldroyd
Glenwood Town President
Glenwood, Utah 84730

Ivan Cowley
Venice, Utah 84777

Mark B. Ross, President
Elsinore, Utah 84724

Theron Mills
Joseph Town President
Joseph, Utah 84739

Elwin Hoyle, Town President
Annabella, Utah 84711

Mr. Alan Boss
Utah Divison of Wildlife Resources
400 West 600 North
Richfield, Utah 84701

Geothermal Steam Public Meeting Mailing List

Mr. William D. Hurley
District #3 Engineer
Utah Department of Highways
Richfield, Utah 84701

Shell Oil Company
352 Denver
Salt Lake City, Utah 84111

Gulf Oil Corporation
Deseret Building
Salt Lake City, Utah 84101

Phillips Petroleum Company
~~Maxkexkingx~~ 431 South 300 East
Salt Lake City, Utah 84101

David L. Sanders
Sanders Associates
Kaysville, Utah 84037

Steam Corporation of America
312 Kearns Bldg.
Salt Lake City, Utah 84101

Natomas Company
601 California Street
22nd Floor
Sand Francisco, CA 94108

Western Steam Company
1560 Colorado State B nk Bldg.
Denver, CO 80202

Union Oil Company of California
P.O. Box 7600
Los Angeles, CA 90051

DISCRETE OPERATIONS

Acceptance Exploration | Test Drilling | [illegible] | Power plant production | Rehabilitation

COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED						REMARKS
II. LIVING COMPONENTS (Con.)						
B. PLANTS *(Terrestrial)*						
Grasses	-L	-M	-M	-M	+M	Removal of vegetation
Forbs	-L	-M	-M	-M	+M	Removal or damage
Shrubs	-L	-M	-M	-M	O	Removal
Conifers (Pinon-Juniper)	O	-L	-L	-L	O	Removal
Irrigated Crops	O	O	-L	-M	+L	Possible damage from salts
C. ANIMALS *(Aquatic)*	O	O	-L	-L	O	Sediments, brines & temperature changes
D. ANIMALS *(Terrestrial)*						
Mammals	O	-L	-M	-M	+L	Loss of habitat - deer, rabbits etc
Birds	O	-L	-M	-M	+L	Loss of habitat & prey species
Reptiles	O	X	X	X	X	Loss of habitat
Invertebrates	O	X	X	X	X	Loss of habitat
III. INTERRELATIONSHIPS						
A. ECOLOGICAL PROCESSES						
Succession	O	-L	-L	-M	+L	Alteration of growing season and moisture on micro scale which will change succession
Food Relationships	O	[illegible]	[illegible]	[illegible]	+L	Food chain will [illegible]
Community relationships	[illegible]	[illegible]	[illegible]	[illegible]	+L	Moisture change & surface disturbances
IV. HUMAN VALUES						
A. LANDSCAPE CHARACTER						
Inharmonious sound	-L	-M	-M	-M	+M	Sight, sound & smell associated with activities
B. SOCIOCULTURAL INTERESTS						
Educational, Scientific	L	M	M	M	O	Archeological sites damage [illegible]
Cultural Values	-L	-M	-M	-M	O	Change lifestyle of community
Social Welfare	[illegible]	M	M	[illegible]	-L	Income revenue [illegible] tax burden
Attitudes & expectations	L	M	M	M	O	[illegible]

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.

2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.

3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.

4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. BLM Manual 1791, Appendix 2, Environmental Digest.

5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (-) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact; *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (-) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
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   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current BLM capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance

6. *Remarks* – Enter clarifying information.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action: Geothermal Leasing — Monroe - Joseph Geothermal Area
Proposed Action — Lease Federal Lands

2. Stages of implementation
1. Exploration
2 Development
3. Operation
4 Closeout

1	2	3	4

3. DISCRETE OPERATIONS

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	Reconnaissance Exploration	Test Drilling	Production Testing	Power Plant & Production	Rehabilitation	6. REMARKS
I. NONLIVING COMPONENTS						
A. AIR						
Particulate Matter	-L	-L	-L	0	0	
Hydrogen Sulfide	?	-L	-M	-L	0	Accumulation during inversions
Water Vapor - Fog	0	0	-M	-M	0	or as the result of
Other Non condensible gases	0	-L	-M	-M	0	a blowout.
B. LAND						
Soil Structure	-L	-M	-M	-L	0	Loss of soils from all activities
Soil Nutrients	0	-L	-L	-M	0	Contamination from salts
Soil Pollutant	0	-L	-L	-M	+L	Water contamination
Soil Erosion	-L	-M	-M	-M	+L	Disturbance & subsidence
Geologic Structure	0	0	-L	-M	0	Fault slippage, subsidence
Land Use Compatibility	-L	-M	-M	-H	+L	Proximity to towns & cultural features
Land Use Suitability	-L	-L	-M	-M	0	area near Monroe, steep terrain
C. WATER						
Hydrologic Cycle	0	-L	-M	-M	+L	Use of subsurface water could alter
						Flow patterns & change temperatures.
Dissolved Solids	0	0	-M	-M	0	Alteration of flows & injections of
						salts
Chemicals, Heavy Metals & Toxic Substances	0	-L	-L	X	0	
Temperature	0	-L	-M	-M	0	Spring temperatures may change
						From production
II. LIVING COMPONENTS						
A. PLANTS (Aquatic)						
Vascular	0	0	-L	-L	+L	Change in temperature &
Phyto plankton	0	0	-L	-L	+L	dissolved solids may affect
						aquatic plants.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action: Geothermal Leasing: Action Do Not Lease (No Action)

2. Stages of implementation:

3. DISCRETE OPERATIONS: No Action

	4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS					6. REMARKS
I. NONLIVING COMPONENTS	A. AIR	0					
	B. LAND	0					
	C. WATER	0					
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*	0					

	DISCRETE OPERATIONS	No Action					
	COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Con.)	B. PLANTS *(Terrestrial)*	0					
	C. ANIMALS *(Aquatic)*	0					
	D. ANIMALS *(Terrestrial)*	0					
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES	0					
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER	0					
	B. SOCIOCULTURAL INTERESTS Social Welfare	-H					Loss of potential income & energy source.
	Attitude & expectations	-H					Federal government's commitment to develop alternate source of energy not fulfilled.

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.

2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.

3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.

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6. *Remarks* – Enter clarifying information.

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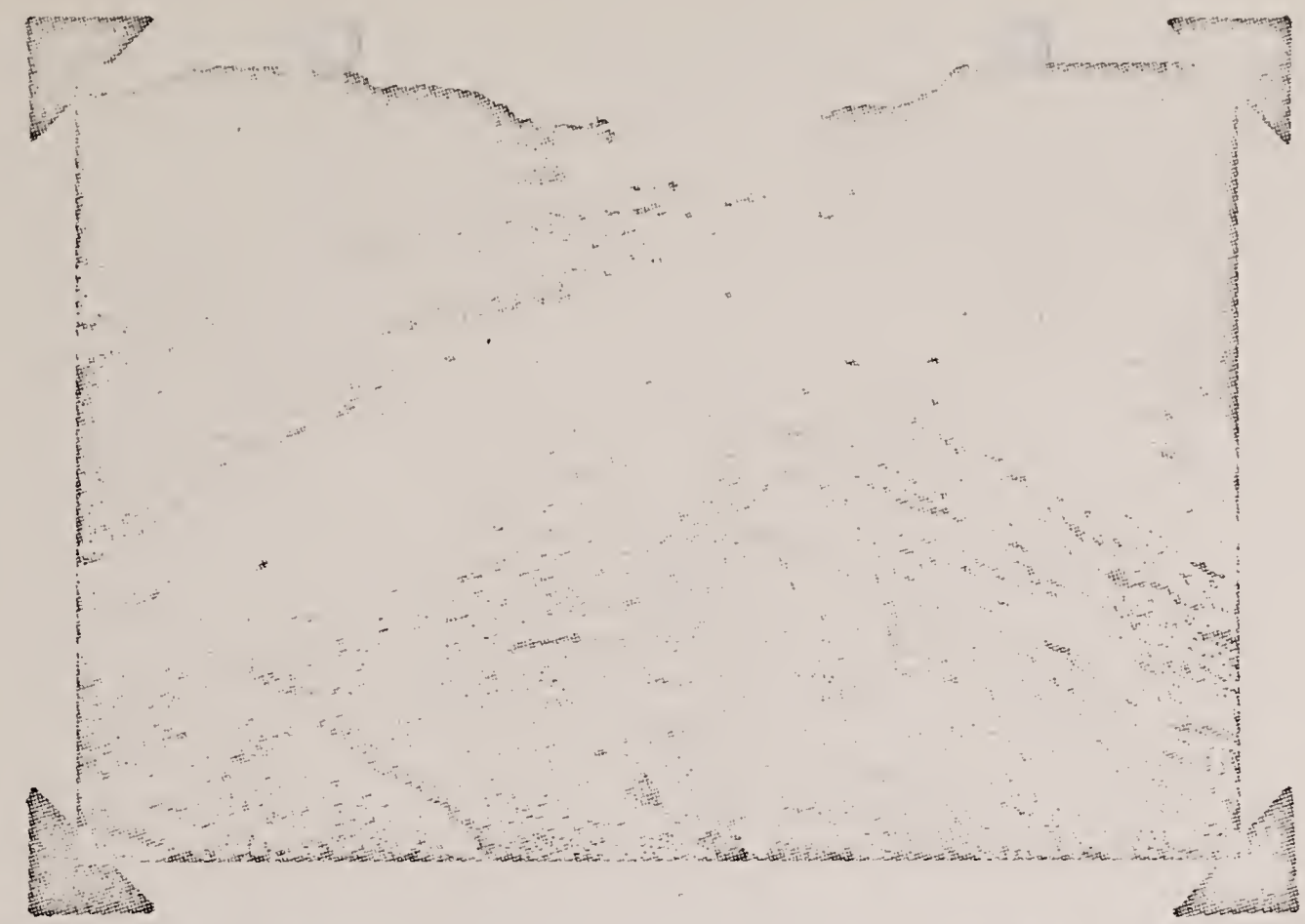
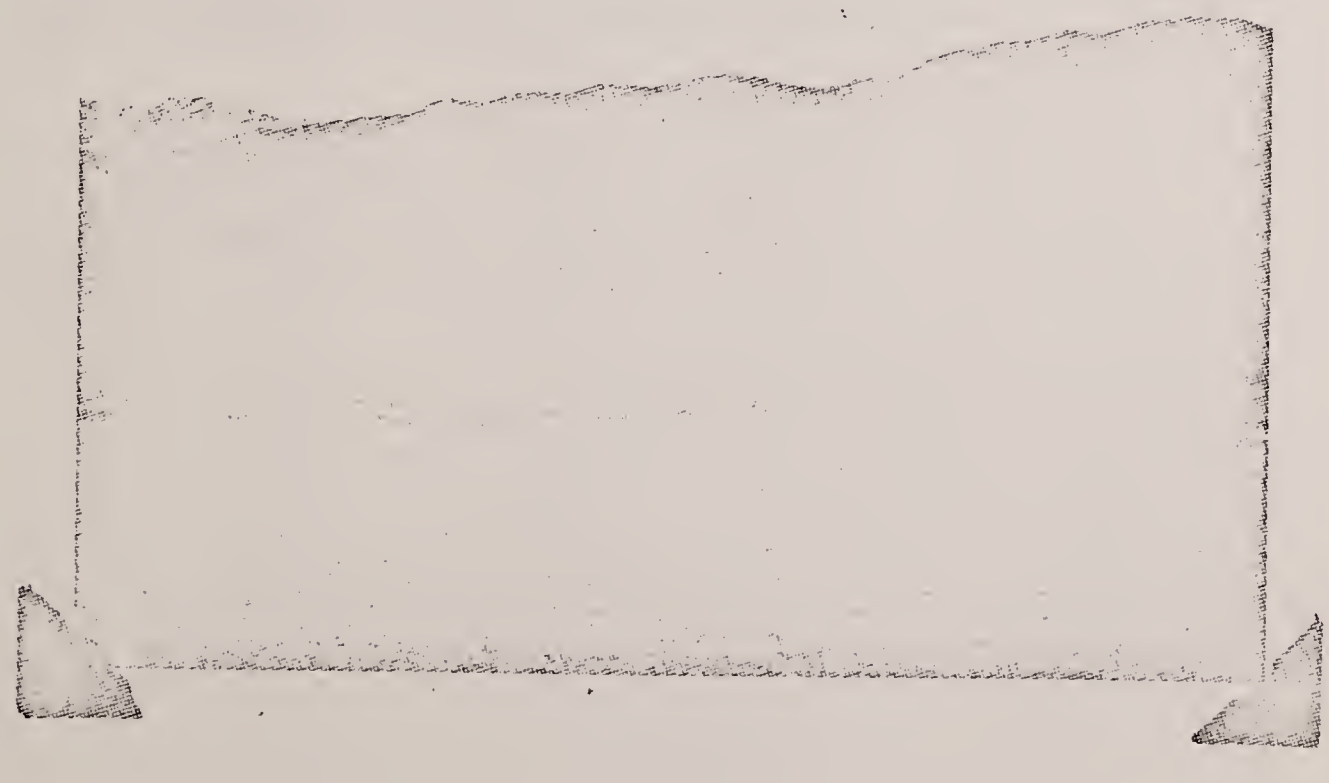


1. Tufa Mound - Monroe (private land)

2. Red Hill Hot Springs - Monroe (private land)

3. KGRA - South of Monroe



4. Private, Forest Service & BLM lands in Monroe KGRA

STATE OF UTAH
Calvin L. Rampton, Governor
DEPARTMENT OF
DEVELOPMENT SERVICES
Division of State History
Melvin T. Smith, Director
603 East South Temple
Salt Lake City, Utah 84102
Telephone: (801) 328-5755

B L M - RICHFIELD	
Route	Action
L M	
H M & O	
Lemmon	✓
Rubow	✓

MAR 1975

A O		
H M B A		
S W R A	✓	
X Action	✓ Info	

March 4, 1975

Mr. Edward L. Fisk
Acting District Manager
Bureau of Land Management
850 North Main Street
Richfield, Utah 84701

Dear Mr. Fisk:

Thank you for your letter (3200) of February 19, 1975. Our review concurs with the adequacy of the archeological survey; however, we are apprehensive about the historic sites although our own files do not list any. We question that a literature review is adequate. Perhaps your plans call for a more detailed review of cultural properties.

Sincerely,

Melvin T. Smith
Director

MTS:hm

3200

Richfield District Office
850 North Main Street
Richfield, Utah 84701

February 19, 1975

Dr. Melvin Smith, Director
Division of State History
603 East South Temple
Salt Lake City, Utah 84102

Dear Dr. Smith:

The Richfield District, Bureau of Land Management is currently preparing an environmental assessment for proposed geothermal leasing in the Monroe-Joseph area of Sevier County (Figure 1). To comply with N.E.P.A. and Section 106 of the National Historic Preservation Act, we solicit verification or comments you may have on cultural and historic values on the public lands proposed for lease.

An archeological survey was made by our BLM Staff Archeologist, Lalar Lindsay. He documented the following sites within the proposed lease area:

Site	Site Type	Location
42 SV 612	Petroglyph	Foothill
42 SV 613	Petroglyph	Foothill
42 SV 614	Chipping Station	Foothill
42 SV 615	Petroglyph	Foothill
42 SV 616	Petroglyph	Valley
42 SV 617	Chipping Station	Valley
42 SV 618	Chipping Station	Foothill
42 SV 619	Petroglyph	Foothill
42 SV 621	Chipping Station	Foothill
42 SV 622	Chipping Station	Foothill
42 SV 623	Chipping Station	Mountain
42 SV 624	Chipping Station	Mountain
42 SV 625	Encampment	Mountain
42 SV 626	Chipping Station	Mountain
42 SV 627	Chipping Station	Mountain
42 SV 628	Chipping Station	Mountain
42 SV 629	Chipping Station	Mountain
42 SV 630	Chipping Station	Foothill
42 SV 457	Petroglyph	Foothill
42 SV 611	Chipping Station	Foothill

The distribution of these sites are shown in Figure 10. Mr. Lindsay's report has been forwarded to the State Archeologist (Dr. David Madsen).

From our literature review and field work, we were unable to identify any historical structures or cultural values from anglo settlement located on the public lands within the proposed lease area.

We would appreciate verification of above conclusions.

Sincerely yours,

Edward L. Fisk,
Acting District Manager

Enclosures
Figure 1
Figure 10

RCDuncan:lo

ARCHAEOLOGICAL VALUES

PETROGLYPH SITES ■

TEMPORARY ENCAMPMENTS ●

CHIPPING STATIONS ▲

R. 3 W.

R. 4 W.

T. 25 S.

T. 26 S.

FISHLAKE NATIONAL FOREST

GEOTHERMAL AREA

Figure 10

MONROE-JOSEPH GEOTHERMAL AREA

K.G.R.A.

K.G.R.A. Competitive Interest

Existing Noncompetitive Applications

Additional Area For Lease

R.3W

R.4 W.

T. 25 S.

FISHLAKE NATIONAL FOREST

Figure 1

STATE OF UTAH

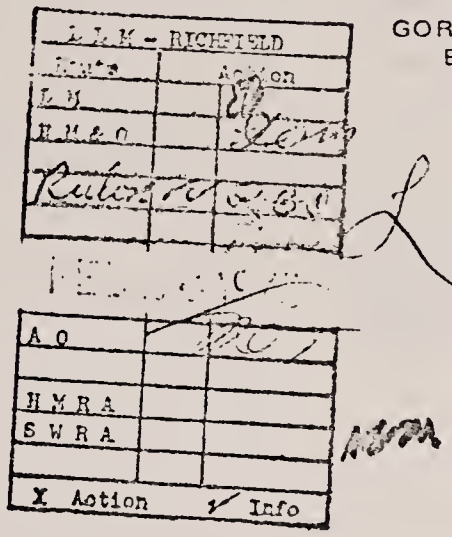
DEPARTMENT OF NATURAL RESOURCES

438 STATE CAPITOL / SALT LAKE CITY, UTAH 84114

CALVIN L. RAMPTON
Governor

GORDON E. HARMSTON
Executive Director

February 21, 1975



Mr. Fearl M. Parker
District Manager
Bureau of Land Management
305 North Main Street
Richfield, Utah 84701

Dear Mr. Parker:

Thank you for your notification through the State Clearinghouse about the preparation of an environmental analysis for proposed geothermal leasing in the Monroe-Joseph area of Sevier County.

The State Environmental Coordinating Committee (composed of representatives from 20 state agencies) is now aware of the proposal. This committee will review the assessment when it is finished, and we hope that appropriate state agencies can make helpful input to the assessment.

Your staff should feel free to make contact with state agency representatives for information related to the preparation of the assessment.

Sincerely,

Dale

Dale B. Carpenter
Chairman, Environmental
Coordinating Committee

DBC:r

Calvin L. Rampton
Governor

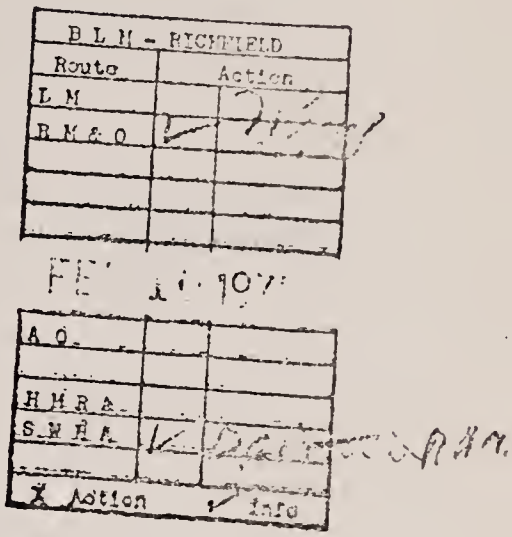
Burton L. Carlson
State Planning
Coordinator

STATE OF UTAH

Office of the

STATE PLANNING COORDINATOR

118 State Capitol
Salt Lake City, Utah 84114
(801) 328-5246



February 7, 1975

Mr. Fearl M. Parker
District Manager
Bureau of Land Management
305 North Main Street
Richfield, Utah 84701

Dear Mr. Parker:

The Environmental Coordinating Committee appreciates being notified of the preparation of the Environmental Analysis for geothermal leasing in the Monroe-Joseph area and for the opportunity to make comments.

In reviewing the material you provided, several questions and concerns were generated along with a desire for more information on specific points. It was decided that members desiring information or having comments would contact you individually rather than trying to make a statement of the ECC's position at this time.

You will undoubtedly be hearing from these members soon and the ECC looks forward to receiving the analysis upon its completion.

We appreciate your cooperation.

Sincerely,

Jerrold L Wood
ECC Secretary

JLW/els

state of utah

DIVISION OF WILDLIFE RESOURCES

JOHN E. PHELPS
Director

1596 West North Temple / Salt Lake City, Utah 84116 / 801-328-5081

Reply To
SOUTHERN REGIONAL OFFICE
622 North Main Street, Box 606, Cedar City, Utah 84720
(801) 586-6803

February 4, 1975

Fearl Parker, District Manager
Richfield District Office
Bureau of Land Management
Richfield, Utah 84701

Dear Fearl:

This is in response to your proposed action to lease federal lands in the Monroe-Joseph area to geothermal development interests.

Wildlife populations found in the proposed lease area are as follows:

Deer

A substantial portion of the deer from Monroe Mountain winter in the general area of the proposed lease. It is likely that some 1,000 deer from Unit 48 (approximately 1% to 15% of the herd) depend upon this area for critical winter range. (See attached map.) On the west side of the valley critical deer winter range is also found within the proposed lease area but far fewer numbers of deer are involved.

The actual overlaps in terms of estimated percent of critical deer winter range covered by the proposed lease for the Monroe-Joseph area are as follows:

Deer Herd	Estimated percent of critical winter range covered by proposed lease.	Estimated percent of total deer in unit affected by proposed lease.
Unit 48	90%	10-15%
Unit 55	10%	1-2%

No other hoofed big game are known to occur in this area.

Upland Game

Chuckar partridge are found in scattered but occasionally large flocks throughout the proposed lease area. This area probably serves as nesting and brood raising cover in addition to year-round cover for these birds. Pheasants are found occasionally using this area although their primary habitat is the agricultural area below the federal lands.

Cottontail rabbits are found throughout the sagebrush-rabbitbrush draws of the lease area. Although not a game animal, the black-tailed jackrabbit is common throughout the area.

Raptors

Bald and Golden eagles are both common winter residents in the area and are believed to depend upon the rabbit population for survival. Golden eagles probably nest in the rocky ledges above the proposed lease site. A host of smaller raptors including the Red-tailed, Rough-legged, and Swainsons hawks and the Great Horned and Long-eared owls are also common, especially during the fall and winter.

Predators

The mountain lion is found occasionally in the proposed lease area while bobcats are common. The coyote is a very common resident, especially in the winter.

Probable impacts on wildlife populations are difficult to assess. The greatest potential for serious detrimental impact as a result of geothermal exploration and development would no doubt be on the wintering deer habitat and the animals themselves, of deer herd unit 48. Exploration activities and construction of buildings, roads, pipelines, etc. would have an adverse affect on wintering deer. Operation and maintenance of any facilities built on the winter range would disrupt their normal use of critical winter habitat. Roads, would enhance public use of this area thereby creating greater disturbance and increasing the chances of poaching and harrassment of the animals.

These same activities would affect all other wildlife using the area but the impacts on the various species would be expected to be less severe as in the case of the deer herd. One exception to this could be the wintering eagle population. These birds spend much of their time hunting the habitat covered by the proposed lease and any activities here could affect them adversely.

The indirect impact of more people brought into Sevier valley as a result of a large geothermal development may well be the heaviest impact on all surrounding wildlife populations. More people means greater hunting pressure on game species and more disturbance of wildlife from four-wheel drive or other recreation vehicles. Equally important is the demand for housing and the resultant loss of habitat.

We understand that considerable leasing of private lands has already occurred and geothermal exploration will begin soon in many areas of Sevier valley. Further, we are aware of at least four other proposed geothermal areas that either have been or very likely will be approved for leasing in the near future in the Beaver-Milford area on B.L.M. and forest lands. We anticipate impacts on wildlife will not be serious in these other areas.

In view of the great potential for conflicts with important wildlife species in the Monroe-Joseph area, we recommend that geothermal leasing of public lands not be allowed at this time. It appears to us that the on-going private land exploration may well prove the value of any geothermal resource in this area and make it unnecessary to open public lands to this activity. However, if the private land exploration reveals a valuable geothermal resource and public land development is also needed, then leasing could be accomplished at a later date with appropriate safeguards to the wildlife resource stipulated.

We realize the importance of developing all possible alternative energy sources. We also know that Utah has great potential for development of many of these energy sources and, where wildlife impacts do not appear to be severe, we feel exploration and development is justified. However, the Monroe-Joseph proposal appears to have a great potential to seriously affect a major big game resource and could adversely affect other important species, both directly and indirectly. We recommend therefore, that the Monroe-Joseph leasing proposal be postponed until a future date when adjacent geothermal project results can be evaluated.

Sincerely,

S. M. Clark
Regional Supervisor

SMC:rh

Copies to Earl Sparks
Leo Hovinga

MONROE-JOSEPH
EOTHERMAL AREA

K.G.R.A. . . .

K.G.R.A. COMPETITIVE
Interest . . .

Existing – Noncompetitive
Applications . . .

dditional Area For
Lease . . . .

I-70

RICHFIELD

GLENWOOD

ANNABELLA

ELSINORE

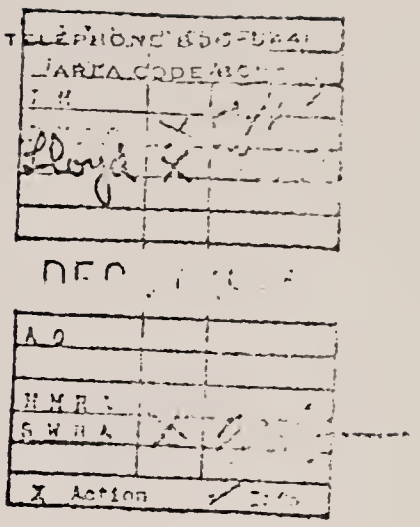
MONROE

Upper limits in average winter (Deer)

Deer Winter range in severe winter

MATTSSON, JACKSON & McIFF
ATTORNEYS AT LAW
151 NORTH MAIN STREET
RICHFIELD, UTAH 84701

CARVEL MATTSSON
NORMAN H. JACKSON
K. L. McIFF



December 11, 1974

Mr. Fearl Parker
District Manager
Bureau of Land Management
850 North Main Street
Richfield, Utah 84701

Dear Mr. Parker: Re: Geothermal Development

I am writing to you in behalf of Karl G. Mecham and Southwest Land and Mortgage of Monroe, Utah. Please make this letter a part of your study file and environmental impact statement in connection with geothermal development in Sevier County, State of Utah.

The following factors should receive serious consideration in connection with this matter:

1. All waters in the State of Utah are administered by the State through the State Engineer's Office. Southwest Land and Mortgage, c/o Karl G. Mecham, is the owner of the mineral hot springs water, which surfaces on privately owned property east of Monroe, Utah. This water apparently percolates underground in BLM administered lands. Any drilling and extraction of water from BLM lands east of this private property will obviously interfere with this established water right. Since the heat is carried in the water, the same cannot be extracted without interfering with the existing water right any more than the cold from cold water could be used for cooling purposes in a dairy, creamery or otherwise without interfering with the rights of the owner of the water. This interference would ruin the owner's hot mineral baths and swimming development in which there is a substantial investment of capital.

2. Development of a geothermal generating plant on BLM's land on the bench east of Monroe, Utah, would interfere with the development and operation of the Monroe Hot Springs business, with the use of the private property and with the residents' peaceable and quiet enjoyment of the trailer park areas.

3. A geothermal development on the bench east of Monroe, Utah, would stick out like a "sore thumb" and would be visible from miles around, interfering with environmental and aesthetic qualities as they presently exist.

4. Your attention is also directed to Title 43, Section 964, Public Lands, United States Code, which provides as follows:

> "Bath houses, hotels, and accommodations adjacent to mineral or medicinal springs on public lands. - The Secretary of the Interior, upon such terms and under such regulations as he may deem proper, may permit responsible persons or associations to use and occupy, for the erection of bath houses, hotels, or other improvements for the accommodation of the public, suitable spaces or tracts of land near or adjacent to mineral, medicinal or other springs which are located upon unreserved public lands or public lands which have been withdrawn for the protection of such springs; provided, that permits or leases hereunder shall be for periods not exceeding twenty years." (Mar. 3, 1925, c. 458, 43 Stat. 1133).

Our client would like to apply for a permit or lease pursuant to the foregoing in connection with development of the mineral baths and hot springs. We feel his request and application should be given priority for use of BLM administered lands immediately east of Monroe Hot Springs because of the developments which have already been completed to date, in progress and planned.

We would appreciate your advice on the procedure for filing for the mineral baths and hot springs special use permit or lease.

Very truly yours,

Norman H. Jackson

NHJ/pd
cc: Mr. Karl G. Mecham